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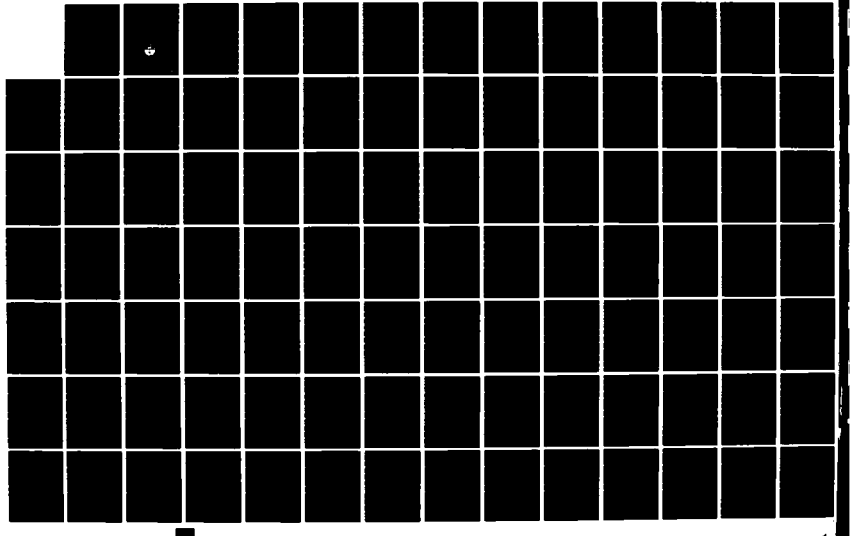

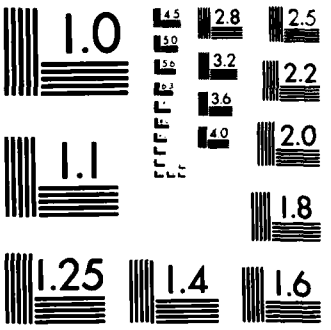

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BIOTECHNOLOGY PREDICTORS OF PHYSICAL SECURITY PERSONNEL PERFORMANCE: I. A REVIEW OF THE STRESS LITERATURE RELATED TO PERFORMANCE

Eleanor R. N. Robinson

Reviewed by
Robert E. Blanchard

Released by
James F. Kelly, Jr.
Commanding Officer

Navy Personnel Research and Development Center
San Diego, California 92152

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The overall purpose of this project is to assess the stability and reliability of such biotechnology predictors as brain event-related potentials (ERPs) in order to use them as performance predictors and assessors against baseline conditions. Comparisons will then be made between candidate ERPs. This report provides (1) an annotated bibliography on stress as related to security guard performance and (2) guidelines for a laboratory task that would discriminably measure brain wave recordings of people experiencing stress.

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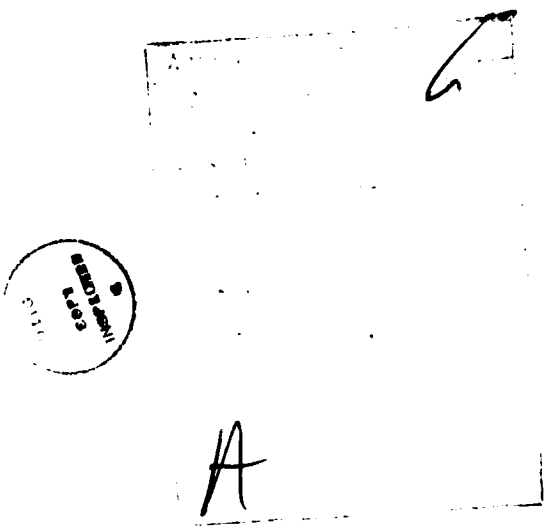
FOREWORD

This research and development was conducted within MIPR 83-507 (Biotechnology Predictors of Physical Security Personnel Performance) in response to Defense Nuclear Agency task code B99QAXRF (Technology Development), program element 62715H. The objective of the project is to determine the feasibility of using biotechnology procedures such as brain event-related potentials (ERPs), muscle activity, and other psychophysiological measures to improve predictions of physical security personnel reliability and performance effectiveness.

The current report, the first in a series to be published on this project, provides an annotated bibliography of the stress literature with emphasis on potential applications for security guard personnel. Subsequent reports will identify procedures to induce stress for further research efforts. Results of this effort are for use by the Nuclear Weapons Physical Security Research and Development program.

JAMES F. KELLY, JR.
Commanding Officer

JAMES W. TWEEDDALE
Technical Director



CONTENTS

INTRODUCTION

Problem

Security guard personnel must stay alert and be prepared to detect, identify, and respond to a variety of potential threats. A security guard's environment, however, includes long periods of little physical activity, which represent a dichotomy of physical and psychological conditions. An important aspect of security personnel reliability is the guard's response to stressful situations after variable periods of physical inactivity. An important factor of this response would be the guard's tolerance to stress. Being able to predict how well a security guard could tolerate duress or stressful situations would greatly increase the performance effectiveness of the physical security force guarding nuclear material.

Objective

The overall objective of the project is to assess the stability and reliability of biotechnology predictors such as brain event-related potentials (ERPs) in order to use them as preformance predictors and assessors against baseline conditions. The objectives of this phase of the project were (1) review the literature that relates specifically to stress in security guards and (2) to suggest guidelines for a laboratory task that may discriminate measures in brain wave recordings of people experiencing stress.

Background

The need for better predictors of security guard personnel performance is detailed in the following excerpts from Lewis (1983).

> The Navy stores and uses nuclear material for ship propulsion systems and nuclear weapons. One of the most crucial aspects of physical security requirements is the security guard force personnel. The guard must remain alert and prepared to detect, identify, and respond to a variety of potential threats. The physical security guard force is often in an environment where too little, rather than too much, activity occurs. One important aspect of personnel reliability is the tolerance to stress by the guard. Being able to predict how well the security guard could tolerate duress or stressful situations would greatly increase the performance effectiveness of the physical security force guarding nuclear material. . . . Brain recordings may provide extremely important information in the area of personnel reliability, that is, assessing and predicting the performance of personnel under duress conditions (e.g., the family taken hostage by terrorists). It may be possible to determine a pattern of responses to a set of stimuli that can provide a basis for identifying personnel who are tolerant to stress conditions.

APPROACH

Over 14,000 titles, abstracts, reports, and books were examined. The 224 references chosen for this literature review were selected specifically for an exploratory experiment that will look for patterns of responses or signature patterns of the brain under stress.

RESULTS AND CONCLUSIONS

Stress Literature

Appendix A provides a summary or overview of references pertaining to the following topic areas: (1) theories and definitions of stress, (2) physiological stress and performance, (3) psychosocial environments and stress, and (4) stress, cognition, and brain recordings. Appendix B is a complete listing of all 224 references, most of which are annotated.

The effects of stress (e.g., being tired on awakening, being exhausted at the end of the day, not being able to relax, and feeling overburdened) are seen as subjective, individual phenomena that are dependent on interactions of physiological, psychological, and environmental factors. Three reasons given for security guards' marginal performance and low morale are lack of a performance product, boredom, and poor motivation. The effects of stress can occur in anyone who feels under pressure and can be measured by physiological, psychological, or performance responses.

Three basic themes are consistent throughout the stress literature:

1. Although stress phenomena are recognized as being the same across disciplines, there is little closure on a definition of "stress." Stress is usually defined in a broad sense using general terms when it is applied between disciplines but can have very different and specific definitions when the term is applied within disciplines.

2. It is recognized that the interactive effects of psychological, physiological, and environmental factors determine the degree of stress perceived by the individual.

3. There is a consistent call for further research in all areas to define and isolate specific contributors to stress in specific situations. One of the most commonly cited criticisms is that temporal factors are often ignored and there should be more concentration on longitudinal studies.

On the plus side, new bioelectrical and biomagnetic procedures that are recorded and analyzed by computers may contribute to research on individual signature patterns for both specific stress situations and different types of individuals (Lewis, 1983). Computers are now an integral part of the research on stress in (1) the presentation, recording, and analysis of data, (2) the design of simulated "penetration" security programs, and (3) systems that are applicable specifically to psychophysiological problems. Salvendy and Smith (1981) describe various aspects of stress from the impact of computer-based work. In comparative studies of automatic control systems, such as the brain and computers, common cybernetic principles have also been found to apply to the motivation and arousal aspects of stress.

Laboratory Task Guidelines

At this point in time, or this point in the research, only general guidelines can be suggested for a laboratory task that would discriminably measure brain wave recordings of people experiencing stress. Variables selected for research should reflect a potential contribution to the understanding of specific effects of stressors on information processing and on the mechanisms that underlie these processes. Some prototype tasks that have been suggested in the literature include vigilance tasks, serial reaction tasks of simple and choice reaction times, tracking tasks, forced-paced tasks, and time-sharing tasks (Hackman, 1970; Hockey, 1979; Laabs & Stager, 1976; Ogden, Levine, & Eisner,

1979; Rabbitt, 1979; Stager & Laabs, 1977; Triggs, 1981; Trumbo, 1973). These tasks are appropriate because they have been heavily researched and found useful in exploring some rather well established models of human performance. Thus, it should be easier to isolate their contribution to a stress performance interaction.

It is very possible that different types of "stress" will evoke different signature patterns in electroencephalograms (EEGs) (Lewis, 1983; Naitoh & Lewis, 1981; Tucker, Ray, & Stern, 1974). Three types of tasks would probably evoke a definite EEG stress pattern. The first type of task would be based on emotion: using holography or film to induce fear or horror. This type of task would, of course, relate directly to a security guard's reaction when directly confronted with an intruder (e.g., increased heart rate, high adrenalin, or increased galvanic skin response (GSR)). The second type of task would be a combination of emotion and information processing using available videotapes of security installations during "penetrating" exercises to simulate stress situations that occur for security guards. This would be a close laboratory approximation of an individual's reactions during a real-world security stress situation. The third type of task would induce specific cognitive or motor overload. Neither cognitive nor motor type tasks would be directly related to a security guard's situation; however, both types have been heavily researched in the literature and may provide baseline measures of a "stress" signature. A security guard is likely to have long periods of vigilance without stimulus and this leads to boredom, the direct opposite of cognitive information overload. The two situations could prove to have very different EEG signatures.

RECOMMENDATIONS

In general, it is recommended that a cognitive overload task, using a combination of simple mathematics such as counting (which has also been well researched) and visuo-spatial abilities be used to produce a quantifiable baseline EEG signature pattern of stress. On the surface, the task would seem to have both internal validity and reliability. Only preliminary testing can verify this premise and whether or not the task will provide reliability. It is also recommended that some physiological measure (e.g., GSR or EKG) be recorded concurrently with the EEG. This would relate the EEG's with prior research in the physiological area. Recommendations for future tasks include using available videotapes of security installations during "penetrating" exercises. Specifically, it is recommended that:

1. Candidate experimental tasks that will predict performance under different types of stressful situations be identified.

2. Dependent measures (physiological, psychological, and environmental) and their interactions be determined that will provide indicators of individual stress responses.

3. An experimental task protocol of instructions and procedures to be followed in each of the candidate task areas be developed.

REFERENCES

Hackman, J. R. Tasks and task performance in research on stress. In J. E. McGrath (Ed.), Social and psychological factors in stress. New York: Holt, Rinehart, and Winston, 1970.

Hockey, R. Stress and the cognitive components of skill performance. In V. Hamilton and D. M. Warburton (Eds.), Human stress and cognition. New York: John Wiley, 1979.

Laabs, G. J., & Stager, P. Monitoring the information-processing demands of attention switching. Canadian Journal of Psychology, 1976, 30(2), 47-54.

Lewis, G. W. Event-related brain electrical and magnetic activity: Toward predicting on-job performance. International Journal of Neuroscience, 1983.

Naitoh, P., & Lewis, G. W. Statistical analysis of extracted features. In N. Yamaguchi and K. Fujisawa (Eds.), Recent advances in EEG and EMG data processing. New York: Elsevier, 1981.

Ogden, G. D., Levine, J. M., & Eisner, E. J. Measurement of workload by secondary tasks. Human Factors, 1979, 21(5), 529-548.

Rabbitt, P. Current paradigms and models in human information processing. In V. Hamilton and D. M. Warburton (Eds.), Human stress and cognition. New York: John Wiley, 1979.

Salvendy, G., & Smith, M. J. (Eds.), Machine pacing and occupational stress. London: Taylor and Francis, Ltd., 1981.

Stager, P., & Laabs, G. J. The effect of divided attention on probe reaction time in multiple-task performance. Canadian Journal of Psychology, 1977, 31(4), 174-183.

Triggs, T. J. Perceptual narrowing and forced-paced tasks. In G. Salvendy and M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor and Francis, Ltd., 1981.

Trumbo, D. A. Some laboratory tasks for the assessment of stressor effects. Psychiatria, Neurologia, Neurochirurgia, (Amst), 1973, 76(3), 199-207.

Tucker, D. M., Ray, W. J., & Stern, R. M. Cognitive structure and EEG asymmetry. Paper presented at the annual convention of the Society for Psychological Research, Salt Lake City, 1974.

APPENDIX A

STRESS AS RELATED TO SECURITY PERFORMANCE: DISCUSSION OF PERTINENT LITERATURE BY TOPIC AREAS

THEORIES AND DEFINITIONS OF STRESS

As suggested by many authors, stress may have several stages. When the mind and/or body are subjected to mental or physical stress, they seem to progress through a continuum, from recognizing the stressor agent by an alarm reaction phase where defenses are mobilized, to a stage of resistance. At this point, full adaptation to the stressor agent may occur and may be followed by a stage of exhaustion where the individual has no more reserves of strategies or strengths to mobilize in defense (Lazarus, 1964; McGrath, 1970a; Pribram & McGuinness, 1975; Selye, 1973, 1979). Stress does not always have negative effects. During the alarm and resistance stages, stress has been shown to improve mental efficiency and worker productivity (Smith, 1981). This adaptation is also known as "eustress" (Selye, 1979). If stress is continued for too long (i.e., into the final exhaustion stage), or if there is too much stress at one time, a corresponding decrease in mental efficiency and increase in emotional response occurs. These results are similar to characteristics of patients with neuroses and character disorders (Horowitz, 1979; Horowitz, Becker & Malone, 1973; Warburton, 1979b). If the stress continues too long, death may result.

Definition of Stress

Stress can be defined in several ways. Meister (1981), Sharit and Salvendy (1982), and Hogan and Hogan (1982) provide recent reviews of the problem in achieving an adequate intra-/interdiscipline definition of stress. In some respects, physiological and psychosocial definitions of stress overlap, although each presents specific interpretations for the parent discipline. McMichael (1978) notes that "Despite [interdiscipline] differences in terminology . . . the [stress] phenomena are essentially identical." In the rest of this section, various definitions of stress are presented. Input factors and output measures are also discussed.

A Physiological Definition of Stress

Selye's (1973) "General Adaptation Syndrome" has dominated the physiological stress research since its inception in 1936. The human body goes through three stages--alarm, mobilization, and exhaustion. Related specifically to physiology, stress is a nonspecific response of the body to any demand, or a physiological state that prepares the organism for action. By this definition, a stressor agent is nonspecific since it produces nonspecific responses (Selye, 1979).

Some Psychosocial Definitions of Stress

The dominant psychoanalytic/cognitive theory or model of stress is the concept of a perceived imbalance generated by individual expectations (Lazarus, 1964; Lazarus, Deese, & Osler, 1952; McGrath, 1970a; Welford, 1973). The individual's perceptions, training, expectations, experiences, moods, and appraisals determine the individual's stress reaction. Stress is defined as a substantial imbalance between demand and the capability to respond,

where failure to meet the the demand is seen by the individual as having important consequences: a demand that taxes the adaptive resources (Averill, 1973; McGrath, 1970b; Welford, 1973). Under this definition, there are six sources of stress: task, role, behavior setting, physical environment, social environment, and characteristics or attributes of the person (Kasl, 1978; McGrath, 1976). The perception of expectations is the most common definition for social scientists and, also, is a definition that relates closely with the person/environment fit theory.

Person/Environment Fit Theory. In the person/environment fit theory, at least three factors--individual physiology, psychology, and the environment--interact to produce individual objective and subjective environments (Caplan, Cobb, French, Van Harrison, & Pinneau, 1975; French & Caplan, 1978; Pervin, 1968; Van Harrison, 1978). The discrepancies between the individual's perceived "subjective" environment and the "objective" (or "real") environment produce, in turn, an individual stress "threshold." This threshold determines how the person fits in, or interacts, with particular "objective" environments.

State-Trait Anxiety. Behavioral scientists have differentiated between state anxiety (unpleasant feelings of nervousness, tension, and apprehension with concomitant physiological arousal), and trait anxiety (the tendency to perceive a wide varitey of situations as threatening and respond with anxiety) (Spielberger, 1970). Trait anxiety is a relatively stable individual characteristic and is the primary component of tests for anxiety. This distinction reflects the "predisposition" literature on stress wherein an individual is predisposed to react in greater or lesser degrees to different combinations of stressors due to his/her physiological composition (e.g., physical health, sex, or age) and his/her psychological composition (e.g., social-environmental background, training, and psychological preferences). It is the intereaction of these factors that "predispose" an individual's reactions to stressful situations.

Input Factors

The range of factors that affect the individual include physical, psychological, and sociological stimuli. Physical factors would include (1) the natural physical environment (e.g., heat, cold, light, and magnetism), (2) the artificial physical environment (e.g., atmospheric pollution, mechanical factors such as noise or vibration, and allergy producing man-made synthetics) (Baade, Ellertsen, Johnsen, & Ursin, 1978; Warburton, 1979a; Wilkins, 1982), (3) physical predispositions (e.g., sex, age, handicaps, abilities, and skills) (Coates & Kirby, 1981; Kamon, 1981), and (4) temporal factors (Alluisi & Morgan, 1982). Psychosocial factors may include personality, training (learned coping strategies), emotion, interests, and work, home, and social environments (Beech, 1978; Folkman, Schaefer & Lazarus, 1979; Hamilton, 1979b; Handy, 1978; McGrath, 1970a; McMichael, 1978). In other words, anything that affects the individual may be a stressor.

Output Measures

The effects of stress can be measured by physiological (autonomic or chemical) responses, psychological responses, and performance on tasks. It is the interactions of the physiological, psychological, and environmental conditions that are important. Some stressors may produce behavioral arousal counter reactions that compensate for adverse effects of other stressors (e.g., sleepiness countered by noise that produces arousal) (Poulton, 1978). This type of counter reaction will reduce the total stress effect. One effect, fatigue, is viewed as a generalized response to stress factors that have extended over a period of time. Cameron (1974) found that the cumulative effects of stress over time result in disturbed sleep habits and noted that sleep habits appear very important when assessing the total stress effect.

Summary

Overall, stress is seen as an individual phenomenon that is subjective in nature, and subject to interactive physiological, psychological, and environmental effects (Hamilton, 1979a). The effects of stress can occur in anyone who feels under pressure and can be measured by physiological, psychological, or performance responses.

References

Alluisi, E. A. & Morgan, Jr. B. B. *Temporal factors in human performance* and productivity. In E. A. Alluisi & E. A. Fleishman (Eds.), Human performance and productivity: Stress and performance effectiveness. New Jersey: Lawrence Erlbaum Associates, 1982.

Averill, J. R. Personal control over aversive stimuli and its relationship to stress. Psychological Bulletin, 1973, 80 (4), 286-303.

Baade, E., Ellertsen, B., Johnsen, T. B. & Ursin, H. Physiology, psychology, and performance. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Beech, H. R. Learning: Cause and cure. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Cameron, C. A theory of fatigue. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Caplan, R. D., Cobb, S., French, Jr., J. R. P., Van Harrison, R., & Pinneau, Jr., S. R. Job demands & worker health (HEW Pub. No. (NIOSH) 75-160). Washington, D.C.: U.S. Department of Health, Education, and Welfare, National Institute for Occupational Safety and Health, April 1975.

Coates, G. D. & Kirby, R. H. Organismic factors and individual differences in human performance and productivity. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Folkman, S., Schaefer, C. & Lazarus, R. S. Cognitive processes as mediators of stress and coping. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. John Wiley, 1979.

French, Jr., J. R. P. & Caplan, R. D. Organizational stress and individual strain. In D. W. Organ (Ed.) The applied psychology of work behavior: A book of readings. Dallas, TX: Business Publications, 1978.

Hamilton, V. Human stress and cognition: Problems of definition, analysis, and integration. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979. (a)

Hamilton, V. Personality and stress. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. John Wiley, 1979. (b)

Handy, C. The family: Help or hindrance? In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Hogan, R. & Hogan, J. C. Subject correlates of stress and human performance. In E. A. Alluisi & E. A. Fleishman (Eds.), Human performance and productivity: Stress and performance effectiveness. New Jersey: Lawrence Erlbaum Associates, 1982.

Horowitz, M. J. Psychological response to serious life events. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

Horowitz, M. J., Becker, S. S. & Malone, P. Stress: Different effects on patients and nonpatients. Journal of Abnormal Psychology, 1973, 82 (3), 547-551.

Kamon, E. Aspects of physiological factors in paced physical work. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Kasl, S. V. Epidemiological contributions to the study of work stress. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Lazarus, R. S. A laboratory approach to the dynamics of psychological stress. In G. H. Grosser, H. Wechsler & M. Greenblatt (Eds.) The threat of impending disaster. Cambridge, MA: M.I.T. Press, 1964.

Lazarus, R. S., Deese, J. & Osler, S. F. The effects of psychological stress upon performance. Psychological Bulletin, 1952, 49 (4), 293-317.

McGrath, J. E. A conceptual formulation for research on stress. In J. E. McGrath (Ed.) Social and psychological factors in stress. New York: Holt, Rinehart & Winston, 1970 (a).

McGrath, J. E. Settings, measures, and themes: An integrative review of some research on social-psychological factors in stress. In J. E. McGrath (Ed.) Social and psychological factors in stress. New York: Holt, Rinehart & Winston, 1970 (b).

McGrath, J. E. Stress and behavior in organizations. In M. D. Dunnette (Ed.), Handbook of industrial and organizational psychology. Chicago: Rand McNally, 1976.

McMichael, A. J. Personality, behavioral, and situational modifiers of work stressors. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Meister, D. The problem of stress definition. In G. Salvendy and M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Pervin, L. A. Performance and satisfaction as a function of individual environment fit. Psychological Bulletin, 1968, 69 (1), 56-68.

Pribram, K. H., & McGuinness, D. Arousal, activation and effort in the control of attention. Psychological Review, 1975, 82 (2), 116-149.

Poulton, E. C. Blue collar stressors. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Selye, H. The evolution of the stress concept. American Scientist, 1973, 61 (6), 692-699.

Selye, H. The stress concept and some its implications. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. John Wiley, 1979.

Sharit, J. & Salvendy, G. Occupational stress: Review and reappraisal. Human Factors, 1982, 24 (2), 129-162.

Smith, R. P. Boredom: A review. Human Factors, 1981, 23 (3), 329-340.

Spielberger, C. D. The effects of anxiety on computer-assisted learning. Tallahassee, FL: Florida State University, CAI Center, June 15, 1970.

Van Harrison, R. Person-environment fit and job stress. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Warburton, D. M. Physiological aspects of information processing and stress. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. John Wiley, 1979. (a)

Warburton, D. M. Physiological aspects of anxiety and schizophrenia. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. John Wiley, 1979. (b)

Welford, A. T. Stress and performance. Ergonomics, 1973, 16 (5), 567-580.

Wilkins, W. L. Psychophysiological correlates of stress and human performace. In E. A. Alluisi & E. A. Fleishman (Eds.), Human performance and productivity: Stress and performance effectiveness. New Jersey: Lawrence Erlbaum Associates, 1982.

PHYSIOLOGICAL STRESS AND PERFORMANCE

The physiological effects from stress have received a great deal of attention in the areas of coronary heart disease (Carruthers, 1980; Chesney & Rosenman, 1980; Johns, 1974; Karasek, 1981; Kasl, 1978), psychosomatics (Averill, 1973; Beech, 1978; Ursin, 1978), arousal and motivation (Caplan, Cobb, French, Van Harrison, & Pinneau, 1975; Carroll, 1974; Cooper, 1974; O'Hanlon & Beatty, 1977; Pribram & McGuinness, 1975; Vollmer, 1978), autonomic indices such as testosterone, blood glucose, and growth horomones (Davidson, Smith, & Levine, 1978; Eide & Atteras, 1978; Ellertsen, Johnsen, & Ursin, 1978; Fontaine, 1981; Geddes, 1981; Kalimo, Leppanen, Verkasalo, Peltomaa & Sepala, 1981; Tucker & Sanstead, 1981; Weitzman & Ursin, 1978), vigilance (Carriero, 1977; Davey, 1974; Lindstrom & Mantysalo, 1981; Mackie, 1977; Poulton, 1977), sleep habits and fatigue (Caille & Bassano, 1977; Cameron, 1974; Goodyear, 1974; Oshima, 1981; Pearson, 1981; Poulton, 1978; Sanford, 1971; Takakuwa, 1977; Warburton, 1979a), thermal stress (Macpherson, 1974; Provins, Glenncross & Cooper, 1974; Poulton & Edwards, 1974, 1979), auditory stress (Andressi, 1975; Bryden, 1969; Childs & Halcomb, 1972; Cohen, 1981; Pearson, Shelnutt, & Casey, 1976), and physiological predisposition to stress (Beaumont & Mayes, 1977; Kasl, 1978; Warburton, 1979b; Welch, 1974).

The term "performance" here includes autonomic physiological responses and overt physical responses to tasks that require information processing, such as simple counting, but are not complex problem-solving tasks such as mathematical calculations that would evoke psychological stress.

Stress in the form of psychological duress (Lewis, 1982) may evoke certain physiological responses under conditions similar to increased apprehension during parachute training; that is, coping with or the "mastery of fear" (Levine, Weinberg, & Ursin, 1978). Measurements of autonomic responses under the conditions of a complex stimulus (e.g., parachute training) that combined both fear and novelty were obtained and included plasma cortisol levels (Levine, 1978), plasma testosterone levels (Davidson, Smith & Levine, 1978), epinepherine and norepinepherine in the urine (Hansen, Stoa, Blix & Ursin, 1978), plasma fatty acid levels (Norum & Ursin, 1978), blood glucose (Eide & Atteras, 1978), and hormonal responses (Ellertsen, Johnsen & Ursin, 1978). In summary,

> The group data [from this study] . . . tell a very consistent story. There was a clear activation after the first [parachute] jump, and all variables monitored pick up this activation. There was then a gradual coping process that reduced most of the variables. This strongly suggests the presence of one or two underlying mechanisms that influence the physiological processes monitored. (Ellertsen et al., 1978, p. 119).

Tasks that are slightly complex and require more attention show a significantly higher correct response rate than do simple repetitive, monotonous responses (Cox, 1980; Warburton, 1979a), but correct response rates are

reduced if the task is continued over too long a time. For instance, sonar operators show a significant decrease in visual and aural efficiency after only 4 hours of monitoring a sonar screen (Siegel, 1969) and a similar decline in vigilance has been found after 1/2 hour under laboratory conditions (Broadbent, 1971; Mackie, 1976; Miller & Mackie, 1980). Carriero and Gehringer (1971) provide a substantial review of physiological correlates of attitudes and attitude change for the Army.

Summary

Although there is an abundance of research literature in the area of stress, and especially heart disease, "it should be remembered that we are talking about moderate effects and modest correlations" between unresolved and conflicting results (Kasl, 1978). Research in this area, however, has fairly well established characteristic symptoms of stress such as being tired on awakening, being exhausted at the end of the day, not being able to relax, and feeling overburdened. These characteristics may be generalized predispositions of the individual since systematic desensitization therapy has sometimes been sucessful with patients having these symptoms (Beech, 1978).

References

Andreassi, J. L., de Simone, J. J., Friend, M. A. & Grota, P. A. Hemispheric amplitude asymmetries in the auditory evoked potential with permanent duty. monaural and biaural stimulation. Physiological Psychology, 1975, 3 (2), 169-171.

Averill, J. R. Personal control over aversive stimuli and and its relationship to stress. Psychological Bulletin, 1973, 80 (4), 286-303.

Beaumont, G. & Mayes, A. Do task and sex differences influence the visual evoked potential? Psychophysiology, 1977, 14 (6), 545-550.

Beech, H. R. Learning: Cause and cure. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Broadbent, D. E. Decision and stress. New York: Academic Press, 1971.

Bryden, M. P. Binaural competition and division of attention as determinants of the laterality effect in dichotic listening. Canadian Journal of Psychology, 1969, 23 (2), 101-113.

Caille, E. J. & Bassano, J. L. Biorhythm and watch rhythms: Hemeral watch rhythm and anhemeral watch rhythm in simulated In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Cameron, C. A theory of fatigue. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Caplan, R. D., Cobb, S., French, Jr., J. R. P., Van Harrison, R., & Pinneau, Jr., S. R. Job demands & worker health (HEW Pub. No. (NIOSH) 75-160). Washington, D.C.: U.S. Department of Health, Education, and Welfare, National Institute for Occupational Safety and Health, April, 1975.

Carriero, N. J. Physiological correlates of performance in a long duration repetitive visual task. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Carriero, N. J. & Gehringer, E. C. An annotated bibliography of the literature dealing with the physiological correlates of attitudes and attitude change. Aberdeen Proving Ground, MD: Aberdeen Research & Development Center, Human Engineering Laboratories, December 1971.

Carroll, D. Physiological response to relevant and irrelevant stimuli in a simple reaction time situation. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Carruthers, M. Hazardous occupations and the heart. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Chesney, M. A. & Rosenman, R. Type A behaviour in the work setting. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Childs, J. M. & Halcomb, C. G. Effects of noise and response complexity upon vigilance performance. Perceptual and Motor Skills, 1972, 35, 735-741.

Cooper, C. J. Anatomical and physiological mechanisms of arousal with special reference to the effects of exercise. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Cohen, A. Human factors methodology for stress evaluation in machine-paced jobs: some NIOSH experiences. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Cox, T. Repetitive work. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Davey, C. P. Physical exertion and mental performance. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Davidson, J. M., Smith, E. R. & Levine, S. Testosterone. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Eide, R. & Atteras, A. Blood glucose. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Ellertsen, B., Johnsen, T. B. & Ursin, H. Relationship between the hormonal responses to activation and coping. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Fontaine, C. W. The relationship between catecholamine excretion as a measure of psychological stress and the variables of job performance and gender. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Geddes, L. A. Physiological monitoring in the workplace. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Goodyear, M. D. E. Stress, adrenocortical activity and sleep habits. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Hansen, J. R., Stoa, K. F., Blix, A. S. & Ursin, H. Urinary levels of epinephrine and norepinephrine in parachutist trainees. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Johns, M. W. Stress and coronary heart disease. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Kalimo, R., Leppanen, A., Verkasalo, M., Peltomaa, A. & Seppala, P. Mental strain in machine-paced and self-paced tasks. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Karasek, R. A. Job decision latitude, job design, and coronary heart disease. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Kasl, S. V. Epidemiological contributions to the study of work stress. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Levine, S. Cortisol changes following repeated experiences with parachute training. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Levine, S., Weinberg, J. & Ursin, H. Definition of the coping process and statement of the problem. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Lewis, G. W. Personnel applications of event related brain potentials. In B. Rimland (Ed.), Independent research and independent exploratory development at the Navy Personnel Research and Development Center (NPRDC Spec. Rep. 82-27). San Diego: Navy Personnel Research and Development Center, June 1982 (AD-A117630).

Lindstrom, K. & Mantysalo, S. Attentive behaviour after exposure to continuous industrial noise. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis Ltd, 1981.

Mackie, R. Some human factors that influence reliability of signal detection and identification in surveillance systems (NBS Special Publication 480-24). In R. Mackie (Ed.), The role of behavior science in physical security. Washington, D. C.: National Bureau of Standards, Proceedings of the First Annual Symposium, April 29-30, 1976.

Mackie, R. R. (Ed.). Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Macpherson, R. K. Thermal stress and thermal comfort. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Miller, J. C. & Mackie, R. R. Vigilance research and nuclear security: Critical review and potential applications to security guard performance. HFR Technical Report 2722, 1980.

Norum, K. & Ursin, H. Fatty acid mobilization. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

O'Hanlon, J. F. & Beatty, J. Concurrence of electroencephalographic and performance changes during a simulated radar watch and some implications for the arousal theory of vigilance. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Oshima, M. The mechanism of mental fatigue. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Pearson, R. G. Subjective reports of stress and strain as concomitants of work. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Pearson, R. G., Shelnutt, J. B. & Casey, S. S. Combined tracking and monitoring performance over seven hours under noise. Paper presented at the International Ergonomics Association Congress. Ergonomics, 1976, 19 (3), 355-356.

Poulton, E. C. Arousing stresses increase vigilance. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Poulton, E. C. Blue collar stressors. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Poulton, E. C. & Edwards, R. S. Interactions and range effects in experiments on pairs of stresses: Mild heat and low-frequency noise. Journal of Experimental Psychology, 1974, 102 (4), 621-628.

Poulton, E. C. & Edwards, R. S. Asymmetric transfer in within-subjects experiments on stress interactions. Ergonomics, 1979, 22 (8), 945-961.

Pribram, K. H. & McGuinness, D. Arousal, activation and effort in the control of attention. Psychological Review, 1975, 82 (2), 116-149.

Provins, K. A., Glenncross, D. J. & Cooper, C. J. Thermal stress and arousal. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Sanford, J. F., Steinkerchner, R. E., Cantrell, G. K., Trimble, R. W. & Hartman, B. O. Alertness, fatigue and morale of Air Force sentries. USAF School of Aerospace Medicine, 1971.

Siegel, A. Comparison of the effects of sonar monitoring and reading on cortical evoked potentials. Prepared by Applied Psychological Services, Wayne, PA, in collaboration with Neuropsychological Laboratory, New York Medical College, New York, NY, for the Department of the Navy, Naval Ship Systems Command, Washington, D. C., 17 June 1969.

Takakuwa, E. The function of maintaining concentration (TAF): An approach to the evaluation of mental stress. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Tucker, D. M. & Sanstead, H. H. Spectral electroencephalographic correlates of iron status: Tired blood revisited. Physiology and Behavior, 1981, 26, 439-449.

Ursin, H. Activation, coping, and psychosomatics. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Vollmer, F. Motivational and physiological arousal. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Warburton, D. M. Physiological aspects of information processing and stress. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. John Wiley, 1979. (a)

Warburton, D. M. Physiological aspects of anxiety and schizophrenia. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. John Wiley, 1979. (b)

Weitzman, E. D. & Ursin, H. Growth hormone. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Welch, R. The measurement of physiological predisposition to tenosynvitis. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

PSYCHOSOCIAL ENVIRONMENTS AND STRESS

Since "over half our working lives are spent at work" (Warburton, 1979) it is not surprising that research on psychosocial environmental stressors emphasizes stress in relation to occupational settings. Within this constraint, and abetted by the growing interest in "stress on the job," recent texts and articles include research studies on sociological goals, boredom, the marital compatibility of different personality types, the one and two-career couples, and the psychosocial aspects of stress on computer operators (Beaumont & Mayes, 1977; Brett, 1980; Bridger, 1978; Cohen, Smith & Stammerjohn, 1981; Cooper & Marshall, 1978; Cooper & Payne, 1978, 1980; Hall & Hall, 1980; Johansen, 1978; Organ, 1978; Payne, 1978,1980; Salvendy & Smith, 1981; Sauter, Harding, Gottlieb, & Quackenboss, 1981; Smith, 1981; Weiss, Ilgen & Sharbaugh, 1979; Welford, 1973, 1974).

There is a highly significant interplay between the individual's psychological appraisal and reaction to the physical setting of work and the physical task demands (Chiles, 1982; Kasl, 1980; Poulton, 1978; Ursin, 1978). For example, machine pacing was long considered the culprit in blue collar stress. More recently, it was postulated that the real culprit was failure of blue collar workers to meet modest aspirations, not the machine pacing (Kornhauser cited in Kasl, 1978). This particular stressor, however, does not always result in poor health or other negative ramifications (Beith, 1981; Broadbent & Gath, 1981; Johnson & Sarason, 1979).

The most common poststress effect on social behavior is that, following exposure to stress, the individual demonstrates an insensitivity toward others (Horowitz, 1979; Streufert, Nogami & Streufert, 1981). Interventions that increase personal control or stressor predictability are effective in reducing such poststress effects (Averill, 1973; Cohen, 1980; Ellis, 1978). Results have also shown that stress is intensified when a long-term goal that is about to be realized is replaced with an even more difficult goal (Dashkevich, 1973).

Three reasons given for security guards' marginal performance and low morale are lack of a performance product, boredom, and poor motivation. The guards have a low expectation of being able to cope with a security emergency (Hall, Hanna, Weaver, Benner, Solomonson, & Caldwell, 1979).* O'Hanlon (1981), in assessing stress in short-cycle repetitive work, theorizes that "this stress [is] the result of (1) habituation, (2) diminished arousal leading to transient performance failures, (3) re-occurring compensatory effort, and (4) anticipation of failure with associated feelings of anxiety and hostility." These effects, and their concomitant factors, may also translate and apply to the long-term-vigilance schedules of security guard personnel.

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*Note: For more specific detail in this area, the reader is also referred to Kramer, 1977, 1978, 1979; Lapinsky & Goodman, 1980; Lapinsky, Ramey-Smith, & Margulis, 1981; Miller & Mackie, 1980; Moore, Carpenter, Holt, Koenig & Warnar, 1979; and Swain & Guttmann, 1980.

Boredom, as a type of worker stress, was found to occur more frequently in workers who were younger, restless, and dissatisfied (P. C. Smith, cited in Smith, 1981). Factors of extroversion, intelligence level, degree of ambition, or the propensity to daydream did not predict who would be susceptible to boredom, but drowsiness episodes were found to be an early sign of boredom and a predictor of reduced performance. Boredom and mental fatigue may represent opposite ends of a continuum of stress factors, but, again, the susceptibility to either boredom or mental fatigue is dependent on individual characteristics, as it is with so many other types of stress (Haider, Koller, Groll-Knapp, Cervinka, & Kundi, 1981). The physical and psychosocial work environment can be modified only so far. "Stress on the job" or "stressful jobs" may indicate that the person needs to change work environments, not that the job characteristics need to be changed. Indeed, for some professions, certain job characteristics are not open to change (e.g., police, security personnel, firemen, and fighter pilots).

Kasl (1978) notes that intuitive judgments and interpretations about the stressfulness of various occupations are often not supported by later evidence. Stress was found to be significantly higher among prison guards than among prisoners; further, the suicide rates of policemen, sheriffs, and marshals are at least twice as high as those of teachers, lawyers, and judges. The most frequently mentioned "stresses" by policemen, sheriffs, and marshals dealt with administrative issues and contacts with the court system; direct life threatening events were mentioned much less frequently. However, the possibility exists that such self-reports involve conscious or unconscious defensive distortion. Also, it may be that the reports were obtained after long-term adaptation to the job environment had taken place. In the subjective report by police on what they considered stress (mentioned above) and autonomic responses of military officers and radio operators (Bourne, Rose, & Mason, 1968), neither group associated stress with general danger situations. In the military, it was performing specific tasks (or the feeling of responsibility while performing specific tasks) during the general danger situation that was considered stressful. Performance of these tasks is not required of everyone, but the tasks are assumed necessary for successful completion of the operation and require concentrated attention.

Although physiological (autonomic) responses were obtained from one group and subjective responses were obtained from a second group, neither group found general danger situations to be stressful. Yet, both groups found specific tasks to be stressful under specific conditions (police with paperwork and the military with responsible tasks that needed concentration). This relationship, however, did not extend to findings of "no reliable differences" (subjective or autonomic) between men who had an intimate, vital, and specific role in launching a space vehicle and control subjects whose jobs were not associated with responsibility for the launch. Thus far, there seems to be too little closure between such disparate findings (Kasl, 1978; Smith, 1981).

Summary

The degree of psychosocial environmental stress to which an individual is exposed is directly influenced by his or her choice of occupation. The choice itself probably reflects characteristics that the individual brings to the job; nevertheless, occupation does make a difference. The emphasis in psychosocial environmental stressors is on the individual's perception of the situation; the perceived demands, perceived capabilities, and perceived consequences if demands are not met (Kets de Vries, 1980; McGrath, 1970).

References

Averill, J. R. Personal control over aversive stimuli and its relationship to stress. Psychological Bulletin, 1973, 80 (4), 286-303.

Beaumont, G. & Mayes, A. Do task and sex differences influence the visual evoked potential? Psychophysiology, 1977, 14 (6), 545-550.

Beith, B. Work repetition and pacing as a source of occupational stress. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Bourne, P. G., Rose, R. M. & Mason, J. W. 17-OHCS levels in combat. Archives of General Psychiatry, 1968, 19, 135-140.

Brett, J. M. The effect of job transfer on employees and their families. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Bridger, H. The increasing relevance of group processes and changing values for understanding and coping with stress at work. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Broadbent, D. E. & Gath, D. Symptom levels in assembly-line workers. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Chiles, W. D., Workload, task, and situational factors as modifiers of complex human performance. In E. Alluisi & E. A. Fleishman (Eds.), Human performance and productivity: Stress and performace effectiveness. Hillsdale, NJ: Lawrence Erlbaum, 1982.

Cohen, B. G. F., Smith, M. J. & Stammerjohn, Jr. L. W. Psychosocial factors contributing to job stress of clerical VDT operators. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis Ltd, 1981.

Cohen, S. Aftereffects of stress on human performance and social behavior: A review of research and theory. Psychological Bulletin, 1980, 88 (1), 82-108.

Cooper, C. L. & Marshall, J. Sources of managerial and white collar stress. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Cooper, C. L. & Payne, R. (Eds.) Stress at work. New York: John Wiley, 1978.

Cooper, C. L. & Payne, R. (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Dashkevich, O. V. Experimental analysis of conditions for appearance of emotional stress. (Russ) Zhurnal Vysshei Nervnoi Deyatel'nosti, 1973, 23 (3), 538-544. [PA 54-11052]

Ellis, A. What people can do for themselves to cope with stress. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Haider, M., Koller, M., Groll-Knapp, E., Cervinka, R. & Kundi, M. Psychophysiological studies on stress and machine-paced work. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Hall, D. T. & Hall, F. S. Stress and the two-career couple. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Hall, R. J., Hanna, W., Weaver, R., Benner, P. Solomonson, D., & Caldwell, J. Security personnel performance measurement system: Vol. II An extended discussion of Phase II procedures, results and recommendations (MRC-R-513). Santa Barbara, CA: Mission Research, August 1979.

Horowitz, M. J. Psychological response to serious life events. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. John Wiley, 1979.

Johansen, R. Stress and socio-technical design: A new ship organization. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Johnson, J. & Sarason, I. G. Recent developments in research on life stress. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. John Wiley, 1979.

Kasl, S. V. Epidemiological contributions to the study of work stress. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Kasl, S. V. The impact of retirement. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Kets de Vries, M. F. R. Stress and the entrepreneur. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Kramer, J. J. (Ed.) The role of behavioral science in physical security (NBS SP-480-24). Proceedings of the first annual symposium, April 29-30, 1976. Washington, D.C.: Human Factors Section, Center for Consumer Product Technology, National Bureau of Standards, November 1977.

Kramer, J. J. (Ed.) The role of behavioral science in physical security (NBS SP-480-32). Proceedings of the 2nd annual symposium, March 1977. Washington, D.C.: Center for Consumer Product Technology, National Bureau of Standards, June 1978.

Kramer, J. J. (Ed.) The role of behavioral science in physical security (NBS SP-480-38). Proceedings of the third annual symposium, May 2-4, 1978. Washington, D.C.: Center for Consumer Product Technology, National Bureau of Standards, December 1979.

Lapinsky, Jr., G. W. & Goodman, C. Psychological deterrents to nuclear theft: An updated literature review and bibliography (NBSIR 80-2038). Washington, D.C.: Law Enforcement Standards Laboratory, U.S. Dept. of Commerce, National Bureau of Standards, May 1980.

Lapinsky, G. M., Ramey-Smith, A. & Margulis, S. T. (Eds.) The role of behavioral science in physical security. Proceedings of the fourth annual symposium, July 25-26, 1979 (NBSIR 81-2207 (R)). Washington, D.C.: Center for Consumer Product Technology and Center for Building Technology, National Bureau of Standards, February 1981.

McGrath, J. E. A conceptual formulation for research on stress. In J. E. McGrath (Ed.) Social and psychological factors in stress. New York: Holt, Rinehart & Winston, 1970.

Miller, J. C. & Mackie, R. R. Vigilance research and nuclear security: Critical review and potential applications to security guard performance. HFR Technical Report 2722, 1980.

Moore, R. T., Carpenter, R. J., Holt, A. W., Koenig, A. L. & Warnar, R. B. J. Phase II final report: Computerized site security monitor and response system (NBSIR 79-1725). Washington, D.C.: Computer Systems Engineering Div., Inst. for Computer Sciences and Technology, National Bureau of Standards, U. S. Dept. of Commerce, March 1979.

O'Hanlon, J. F. Stress in short-cycle repetitive work: general theory and an empirical test. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Organ, D. W. (Ed.) The applied psychology of work behavior: A book of readings. Dallas, TX: Business Publications, Inc., 1978.

Payne, R. Epistemology and the study of stress at work. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Payne, R. Organizational stress and social support. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Poulton, E. C. Blue collar stressors. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Salvendy, G. & Smith, M. J. (Eds.) Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Sauter, S. L., Harding, G. E., Gottlieb, M. S. & Quackenboss, J. J. VDT-computer automation of work practices as a stressor in information-processing jobs: some methodological considerations. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Smith, R. P. Boredom: A review. Human Factors, 1981, 23 (3), 329-340.

Streufert, S., Nogami, G. Y. & Streufert, S. C. Stress and incongruity theory: Effects of crowding. University Park, PA: Pennsylvania State University, Feb 1981.

Swain, A. D. & Guttmann, H. E. Handbook of human reliability analysis with emphasis on nuclear power plant applications; draft report for interim use and comment (NUREG/CR-1278). Albuquerque, NM: Sandia Laboratories, prepared for U.S. Nuclear Regulatory Commission, October 1980.

Ursin, H. Activation, coping, and psychosomatics. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Weiss, H. M., Ilgen, D. R. & Sharbaugh, M. E. Effects of life and job stress on information search behaviors of organizational members (ONR-7, Interim Report). West Lafayette, IN: Purdue University, N00014-78-C-0609/ NR170-876, April 1979.

Welford, A. T. Stress and performance. Ergonomics, 1973, 16 (5), 567-580.

Welford, A. T. (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Warburton, D. M. Physiological aspects of anxiety and schizophrenia. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

STRESS, COGNITION, AND BRAIN RECORDINGS

The effects of stress on cognition and emotion have been studied using either performance measures alone (as in attention or signal detection studies) or a combination of brain recordings (electroencephalograms, EEGs) and performance measures (Andreassi, de Simone, Friend, & Grota, 1975; Cumming & Croft, 1974; Davies & Parasuraman, 1977; Hockey, 1979; Kinney & McKay, 1974; Lewis, 1980, 1981, 1982; Musicant, 1975; O'Hanlon & Beatty, 1977; Schechter & Buchsbaum, 1973). Cognition is defined here as the unobservable human intellectual processing of information. Research studies cover a variety of settings (clinics, military installations, prisons, schools, and occupational settings) and populations (patients and nonpatients, military personnel, police, sheriffs, students, blue collar and white collar workers, and prison guards) (Baade, Halse, Stenhammer, Ellertsen Johnsen, Vollmer & Ursin, 1978; Cortical evoked potentials, 1979; Forsyth & Huber, 1976; Korchin & Ruff, 1964; Miles, 1980; Payne, 1979; Pilowsky, 1974).

Although it is not known specifically how the individual produces the results, it is known that cognitive processes mediate stress (Beech, 1978; Horowitz, Becker & Malone, 1973; Mandler, 1979; Ursin, 1978; Warburton, 1979a). Such processes are assumed to be the main contributing factors in biofeedback and desensitization studies. Lapinsky and Goodman (1980) and Lester (1979) provide substantive annotated bibliographies and review the literature in this area. Lapinsky and Goodman assess the literature in terms of psychological deterrants to nuclear theft, while Lester reviews only studies funded by the Department of Defense that pertain to psychological stress.

Current Models of Information Processing

An eclectic summary of recent research and the most "popular" information processing models indicates that during the acquisition process, the individual first scans for any stimulation (alpha activity). When stimulation is found, a faster mechanism is used that scans for structure (beta activity) (Giannitrapani, 1971). Beta activity subsides when the stimuli is recognized (has acquired the necessary structure), and it is hypothesized that there are probably faster scanning mechanisms for more complex processes. The structured information is selectively filtered in a sensory register, encoded in short-term memory (STM) and then in long-term memory (LTM), and, finally, retrieved under certain circumstances (Atkinson & Shiffrin, 1971; Broadbent, 1971; Rabbitt, 1979; Waugh & Norman, 1965).

The processing activity is hypothesized as either a top-down, hierarchical, serial process or a parallel process such as a collection of labeled nodes or webbing as in an electrical schemata wherein activation of one node in the network can activate leads to other nodes (Fiskel & Bower, 1976; Norman & Bobrow, 1975; Norman & Rumelhart, 1975; Schioldborg, 1972). The resources that an individual can allocate to processing are limited and the information is subject to being pushed out of STM by new information and to decay in LTM.

The Lateral Asymmetry Model and Emotion/Anxiety

Split-brain research indicates that the functions of the two halves of the brain differ in several important respects (Dimond, 1977; Lewis, Federico, Froning & Calder, 1981; Tucker, Ray & Stern, 1974; Tucker & Roth, 1982). The left hemisphere is considered the analytical hemisphere (the loci of speech and logic), while the right hemisphere is considered the visuospatial center (superior for recognizing faces and the loci of emotion) (Ley & Bryden, 1979; Sackeim, Gur & Saucy, 1978; Shearer & Tucker, 1981). The right hemisphere shows superiority for the perception of nonverbal materials. Although there is greater right hemisphere activation during emotional arousal, there is some evidence that emotion is also present to some degree in the left hemisphere, especially for highly anxious persons, and that emotion in both hemispheres is modulated by the frontal regions of the brain.

It has been shown that emotion contributes to reduced activity in both hemispheres (Tucker, 1978, 1981a; Tucker, Antes, Stenslie & Barnhardt, 1978; Tucker & Newman, 1981; Tucker & Sanstead, 1981; Tyler & Tucker, 1982). The right hemisphere reduces activity when the individual is in a depressed mood, and the left hemisphere reduces activity in highly anxious individuals. The disruption of left hemisphere cognition under anxiety supports clinical observations that arithmetic and digit span IQ subtests are the most sensitive to characterisitics of anxiety (Tucker, Roth, Arneson, & Buckingham, 1977; Tucker, Stenslie, Roth & Shearer, 1981).

As mentioned in Theories of Stress, trait anxiety is a relatively stable characteristic and is the primary component of most tests for anxiety. For example, it is easier for nonpatients to subdue fear and nervousness after being emotionally stressed than it is for patients with neuroses and character disorders (Horowitz, 1979; Horowitz, Becker & Malone, 1973; Hamilton, 1979; Warburton, 1979a, 1979b). Such patients have a sustained and much higher stress threshold, and cannot easily subdue continuing intrusive thoughts after emotional arousal. Sensory interaction may influence higher-order cognitive processing such as reading, and both memory and perception contribute to the effects of hemispheric difference in the recognition of verbal and nonverbal materials (Hatta, 1975, 1976; Lewis & Froning, 1981).

Sex Differences

Differences in information processing have been observed for males and females as measured by EEG recordings. Females show differential hemisphere involvement in spatial tasks, whereas males show more specialization in both hemispheres for different tasks (Beaumont & Mayes, 1977; Davidson, 1981; Dumas & Morgan, 1975; Ray, Morell, Frediani & Tucker, 1976; Schwartz, Davidson & Maer, 1975). It has been suggested that males show right hemisphere specialization for visuospatial tasks and also show more left hemisphere specialization for verbal tasks. In other words, males are shown to lateralize more than females, but females can subdue "cross talk" between the hemispheres when it is efficient to do so. "The implication of such data is that the left hemisphere is more specialized in males than females for at

least some kinds of verbal processing" (Tucker, 1976). It has been noted that the ability to combine the capacities of both hemispheres (bilateral activation) is associated with a field independent cognitive style as opposed to hemisphere differentiation, which is associated with a field dependent style (Dawson, Tucker & Swenson, 1982).

Security Personnel and Brain Recording Research

Recent advances in brain hemisphere research include new biomagnetic procedures that are more sensitive to individual differences than is bioelectric activity. Biomagnetic procedures have several advantages: the apparatus has no physical contact with the body, artifact "noise" such as muscle activity is minimized or eliminated, the usual "reference" recording site necessary in bioelectrical measures is eliminated, and greater localization of activity is possible because only activity below the coil is measured. Naitoh and Lewis (1981) suggest that "individual ERP [event related potential] waveforms may be as stable as a fingerprint." The current status of EEG research as related to security guards is best summarized by Tucker (1981b):

> In many ways, for a responsible position the individual with strong left hemisphere functions will be dependable, well-ordered and vigiliant; however, under stress this person may become overly detailed-oriented and too tightly inhibited to respond reflexively to the overall global structure of the situation. The low-anxiety individual, on the other hand, is seldom overcome by stress, and often seeks out excitement, since it gives him a noradrenergic high. Whereas this person is the one who will cope well in dangerous situations, and will show good global conceptual skills, his poor verbal abilities may often pose difficulties, and he may show a sufficient number of psychopathic traits to be a dubious choice as a security risk . . . . These personality generalizations . . . are congruent with the model of personality functions emerging from the literature on lateral brain function and cognitive style . . . . In the preprint by Tyler and Tucker [1982] you can see how situational and trait factors interact. There are thus no easy predictions of how someone will respond to stress, but understanding how emotion is handled in the two cerebral hemispheres is helpful. (p.1)

References

Andreassi, J. L., de Simone, J. J., Friend, M. A. & Grota, P. A. Hemispheric amplitude asymmetries in the auditory evoked potential with monaural and biaural stimulation. Physiological Psychology, 1975, 3 (2), 169-171.

Atkinson, R. C. & Shiffrin, R. M. The control of short-term memory. Scientific American, August, 1971, 82-90.

Baade, E., Halse, K., Stenhammer, P. E., Ellertsen, B., Johnsen, T. B., Vollmer, F. & Ursin, H. Psychological tests. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Beaumont, G. & Mayes, A. Do task and sex differences influence the visual evoked potential? Psychophysiology, 1977, 14 (6), 545-550.

Beech, H. R. Learning: Cause and cure. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Broadbent, D. E. Decision and stress. New York: Academic Press, 1971.

Cortical evoked potentials associated with learning and cognitive processes (SSIE DK13-97). Washington, D.C.: Smithsonian Science Information Exchange, July 1979.

Cumming, R. W. & Croft, P. G. Human information processing under varying task demand. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Davidson, R. Functional asymmetry in the brains of men and women. Paper presented at Harvard, March 3, 1981. (Received from J. T. Lester, ONR, Boston)

Davies, D. R. & Parasuraman, R. Cortical evoked potentials and vigilance; A decision theory analysis. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Dawson, S. L., Tucker, D. M. & Swenson, R. A. Lateralized cognitive style and self-description bias (manuscript in preparation). Grand Forks, ND: University of North Dakota, Dept. of Psychology, 1982.

Dimond, S. J. Vigilance and split-brain research. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Dumas, R. & Morgan, A. EEG asymmetry as a function of occupation, task and task difficulty. Neuropsychologia, 1975, 13 (2), 219-228.

Fiskel, J. R. & Bower, G. H. Question-answering by a semantic network of parallel automata. Journal of Mathematical Psychology, 1976, 13, 1-45.

Forsyth, G. A. & Huber, R. J. Selective attention in ambiguous-figure perception: An individual difference analysis. Bulletin of the Psychonomic Society, 1976, 7 (6), 498-500.

Giannitrapani, D. Scanning mechanisms and the EEG. Electroencephalography & Clinical Neurophysiology, 1971, 30 (2), 139-146.

Hamilton, V. Information processing aspects of neurotic anxiety and the schizophrenias. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

Hatta, Takeshi. Functional hemispheric asymmetry in perception of random forms. The Japanese Journal of Psychology, 1975, 45 (5), 152-161.

Hatta, Takeshi. Functional hemispheric asymmetries in perception of digit and line orientation. The Japanese Journal of Psychology, 1976, 47 (5), 268-276

Hockey, R. Stress and the cognitive components of skilled performance. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

Horowitz, M. J. Psychological response to serious life events. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

Horowitz, M. J., Becker, S. S. & Malone, P. Stress: Different effects on patients and nonpatients. Journal of Abnormal Psychology, 1973, 82 (3), 547-551.

Kinney, J. S. & McKay, C. L. The visual evoked cortical potential as a measure of stress in naval environments: III. The response to pattern and color. U.S. Naval Submarine Medical Research Laboratory Report, 1974(Mar), No. 778, 19 p.

Korchin, S. J. & Ruff, G. E. Personality characteristics of the Mercury astronauts. In G. H. Grosser, H. Wechsler & M. Greenblatt (Eds.) The threat of impending disaster. Cambridge, MA: M.I.T. Press, 1964.

Lapinsky, Jr., G. W. & Goodman, C. Psychological deterrents to nuclear theft: An updated literature review and bibliography (NBSIR 80-2038). Washington, D.C.: Law Enforcement Standards Laboratory, U.S. Dept. of Commerce, National Bureau of Standards, May 1980.

Lester, J. T. An annotated bibliography of DoD-funded reports concerning psychological stress: 1950-1978. Boston, MA: Office of Naval Research, Eastern/Central Regional Office, September 1979.

Lewis, G. W. Job performance and brain asymmetry: Relevance for physical security personnel. Presented at the Fifth Annual Meeting on the Role of Behavioral Science in Physical Security, held 11-12 June 1980, at the National Bureau of Standards, Gaithersburg, Maryland.

Lewis, G. W. Biotechnology predictors of physical security personnel performance. Presented at the Sixth Annual Meeting on the Role of Behavior Science in Physical Security, held 3-4 June 1981, Washington, D.C.

Lewis, G. W. Personnel applications of event related brain potentials. In B. Rimland (Ed.), Independent research and independent exploratory development at the Navy Personnel Research and Development Center. (NPRDC Spec. Rep. 82-27). San Diego: Navy Personnel Research and Development Center, June 1982. (AD-A117 630)

Lewis, G. W., Federico, P-A., Froning, J. N. & Calder, M. Event related brain potentials and cognitive processing: Implications for Navy training (NPRDC TR 82-8). San Diego: Navy Personnel Research and Development Center, October 1981. (AD-A109 019)

Lewis, G. W. & Froning, J. N. Sensory interaction, brain activity, and reading ability in young adults. International Journal of Neuroscience, 1981, 15, 129-140.

Ley, R. G. & Bryden, M. P. Hemispheric differences in processing emotions and faces. Brain and Language, 1979, 7, 127-138.

Mandler, G. Thought processes, consciousness and stress. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

Miles, R. H. Boundary roles. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Musicant, R. A. Evoked potentials and attention. Biological Psychology Bulletin, 1975, 4 (1), 1-9.

Norman, D. A. & Bobrow, D. G. On data-limited and resource-limited processes. Cognitive Psychology, 1975, 7, 44-64.

Norman, D. A. & Rumelhart, D. E. Explorations in cognition. San Francisco: Freeman, 1975.

O'Hanlon, J. F. & Beatty, J. Concurrence of electroencephalographic and performance changes during a simulated radar watch and some implications for the arousal theory of vigilance. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Payne, R. L. Stress and cognition in organizations. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

Pilowsky, I. Psychiatric aspects of stress. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Rabbitt, P. Current paradigms and models in human information processing. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

Ray, W. J, Morell, M., Frediani, A. W. & Tucker, D. M. Sex differences and lateral specialization of hemispheric functioning. Neuropsychologia, 1976, 14, 391-393.

Sackeim, H. A., Gur, R. C. & Saucy, M. C. Emotions are expressed more intensely on the left side of the face. Science, 27 October 1978, 202, 434-435.

Schechter, G. & Buchsbaum, M. The effects of attention, stimulus intensity, and individual differences on the average evoked response. Psychophysiology, 1973, 10 (4), 392-400.

Schioldborg, P. Selective attention in visual perception and short-term memory: "Stimulus" set versus "response" set. Scandanavian Journal of Psychology, 1972, 13 (3), 172-177.

Schwartz, G. E., Davidson, R. J. & Maer, F. Right hemisphere specialization for emotion: Interactions with cognition. Science, 1975 190, 286-290.

Shearer, S. I. & Tucker, D. M. Differential cognitive contributions of the cerebral hemispheres in the modulation of emotional arousal. Cognitive Therapy and Research, 1981, 5 (1), 85-93.

Tucker, D. M. Sex differences in hemispheric specialization for synthetic visuospatial functions. Neuropsychologia, 1976, 14, 447-454 (Pergammon Press, England).

Tucker, D. M. Hemispheric differentiation, integration and cognitive style. Univ. of North Dakota, Dept. of Psychology, 1978.

Tucker, D. M. Lateral brain function, emotion, and conceptualization. Psychological Bulletin, 1981, 89 (1), 19-46. (a)

Tucker, D. M. Personal communication to G. W. Lewis, September 14, 1981. (b)

Tucker, D. M., Antes, J. R., Stenslie, C. E. & Barnhardt, T. M. Anxiety and lateral cerebral function. Journal of Abnormal Psychology, 1978, 87 (3), 380-383.

Tucker, D. M. & Newman, J. P. Verbal versus imaginal cognitive strategies in the inhibition of emotional arousal. Cognitive Therapy and Research, 1981, 5 (2), 197-202.

Tucker, D. M., Ray, W. J. & Stern, R. M. Cognitive structure and EEG asymmetry. Paper presented at the annual convention of the Society for Psychological Research, Salt Lake City, 1974.

Tucker, D. M. & Roth, D. L. Factoring the intercoherence matrix: Multivariate analysis of topographic covariance in the EEG (manuscript in preparation). Grand Forks, ND: University of North Dakota, Dept. of Psychology, 1982.

Tucker, D. M., Roth, R. S., Arneson, B. A. & Buckingham, V. Right hemisphere activation during stress. Neuropsychologia, 1977, 15, 697-700.

Tucker, D. M. & Sanstead, H. H. Spectral electroencephalographic correlates of iron status: Tired blood revisited. Physiology and Behavior, 1981, 26, 439-449.

Tucker, D. M., Stenslie, C. E., Roth, R. S. & Shearer, S. L. Right frontal lobe activation and right hemisphere performance decrement during a depressed mood. Archives of General Psychiatry, Feb 1981, 38, 169-174.

Tyler, S. K. & Tucker, D. M. Anxiety and perceptual structure: Individual differences in neuropsychological function. Journal of Abnormal Psychology, 1982, 91, (3), 210-220.

Ursin, H. Activation, coping, and psychosomatics. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Warburton, D. M. Physiological aspects of anxiety and schizophrenia. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979. (a)

Warburton, D. M. Stress and the processing of information. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979. (b)

Waugh, N. C. & Norman, D. A. Primary memory. Psychological review, 1965, 72, 89-104.

APPENDIX B

STRESS AS RELATED TO SECURITY PERSONNEL PERFORMANCE: ANNOTATED BIBLIOGRAPHY

STRESS BIBLIOGRAPHY
(With selected annotations)*

Alluisi, E. A. Stress and stressors, commonplace and otherwise. In E. Alluisi & E. A. Fleishman (Eds.), Human performance and productivity: Stress and performace effectiveness. Hillsdale, NJ: Lawrence Erlbaum, 1982.

This volume is meant to emphasize the commonplace, and much more frequently occurring, stresses that strain individuals in their everyday life and work. The worker's contribution to productivity is performance--job performance. Both managers and workers should realize that the worker's contributions to increasing productivity are limited, all other things held constant. Those contributions are limited to the increases that can be made in performance effectiveness or to the decreases or disturbances to performance effectiveness that can be reduced or obviated. Thus, performance effectiveness was taken, along with certain commonplace stresses, to be the major focus of this volume. The intent is to provide a review of the state of knowledge in the specific areas of science and technology covered. The hope is that this will show what is known of how these commonplace stresses and performance effectiveness interact, how the worker's performance effectiveness can be maintained or enhanced, and where there are gaps in knowledge that could be addressed by relevant research and development efforts.

Alluisi, E. A., Coates, G. D., & Morgan, Jr. B. B. Effects of temporal stressors on vigilance and information processing. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

The data of two control and ten experimental studies of the effects of continuous work and sleep loss on sustained multiple-task performance, representing more than 9 man-years of synthetic work by 89 different subjects, were reanalyzed to permit comparisons of the performances of three watchkeeping tasks and two active tasks that are time-shared in a multiple-task performance battery (MTPB). Specific comparisons were made of the two control groups, of the effects of 48 hours of continuous work and sleep loss with and without the employment of pulse rate and EEG-theta biofeedback and autoregulation, of the effects of the duration of continuous work and sleep loss (36, 44, or 48 hours), of the effects of the duration of rest and recovery following 36 hours of continuous work (12, 6, 4, 3, and 2 hours), and of circadian rhythm and 36-hour continuous work interactions. Eight specific conclusions are reached, the most general of which is that the

*Note. Comments following each reference are direct quotes of abstracts, summaries, or main arguments from the references. Any comments in brackets are the author's.

relevance of typical laboratory research with single-task watchkeeping tests, including the capability of its findings being generalized to, and implemented in, practical situations involving monitoring performances within operational man-machine systems is seriously questioned, if not compromised, by the findings.

Alluisi, E. A. & Fleishman, E. A. (Eds.) Human performance and productivity: Stress and performance effectiveness. New Jersey: Lawrence Erlbaum Associates, 1982.

There is a need to lay out more clearly and more consistently the relations between productivity and human performance as a prerequisite to more systematic and comprehensive policy planning and research to enhance productivity -- and the quality of life. The objective of this book and the others in this series is to focus attention on some issues of productivity from some new perspectives provided by recent research on human performance . . . . The organization of this series of books is built upon examination of the following three areas: (1) Human capability assessment. This area evaluates the improved techniques to identify, measure, train, and evaluate human capabilities needed. This includes the development of concepts relating to individual and team performance. (2) Information processing and decision making. This area attempts to define the parameters and limits of the human as a processor and integrator of information and as a decision maker in operating systems. (3) Stress and performance effectiveness. This area examines aspects of human performance under environmental, social, situational, and organismic stressors. The goal of this effort would be to reduce or prevent the degradation of performance effectiveness in the presence of conditions that are stressful.

Alluisi, E. A. & Morgan, Jr. B. B. Temporal factors in human performance and productivity. In E. A. Alluisi & E. A. Fleishman (Eds.), Human performance and productivity: Stress and performance effectiveness. New Jersey: Lawrence Erlbaum Associates, 1982.

The improvement of productivity and performance effectiveness through the appropriate management of temporal factors in work has been a recognized goal since the earliest applications of psychology . . . . The work schedule, including the work shift and hours of work, is an important condition of any job. Many of its features are related to custom; others are derived from conditions that are changing or no longer exist. Even the desirability of the standard 8-hour workday, 5-day/40-hour workweek is being questioned in response to both economic and worker-preference productivity factors. There is really little reason to presume that the optimum work schedule would remain unchanged in the fact of the changing conditions of modern life, life styles, and the values attached to work and to leisure activities. Indeed, expanding experiences with a compact (4-day) workweek in the United States and with "flexitime," which was initiated in Western Europe, are emphasizing anew the importance of temporal factors in

human performance and productivity, even as they are raising "myriads of questions" that suggest the research needs are substantial.

It is in order to obtain a clearer understanding of some of these research needs that the present chapter has been prepared. The objectives include: (1) an elucidation of the state of knowledge based on empirical studies from both the laboratory and the field, regarding temporal factors in human performance and productivity, (2) identification of those temporal factors that have major impact, (3) specification of the effects of those factors on work efficiency, with the assessment of means whereby they might be appropriately manipulated or managed to optimize or at least enhance human performance and productivity, and (4) explication of meaningful questions, the importance of which would appear to warrant further research efforts.

Andreassi, J. L., de Simone, J. J., Friend, M. A. & Grota, P. A. Hemispheric amplitude asymmetries in the auditory evoked potential with monaural and biaural stimulation. Physiological Psychology, 1975, 3 (2), 169-171.

Examined auditory evoked potentials (AEPs) in five male and four female students under three conditions of auditory stimulation: left ear, right ear, and the two ears simultaneously. It was hypothesized that the white-noise stimulus would result in higher amplitude AEPs in the contralateral hemisphere as compared to the ipsilateral. This was confirmed. There were no latency differences in AEPs recorded from over ipsilateral and contralateral hemispheres. Results appear to provide further evidence for the predominance of the contralateral pathways of the auditory system.

Atkinson, R. C. & Shiffrin, R. M. The control of short-term memory. Scientific American, August, 1971, 82-90.

Information flow through the memory system is conceived of as beginning with the processing of environmental inputs in sensory registers (receptors plus internal elements) and entry into the short-term store (STS). While it remains there, the information may be copied into the long-term store (LTS), and associated information that is in the long-term store may be activated and entered into the short-term store . . . . Control processes in the short-term store affect these transfers into and out of the long-term store and govern learning, retrieval of information and forgetting . . . . Control processes such as rehearsal are essential to the transfer of information from the short-term store to the long-term store.

Averill, J. R. Personal control over aversive stimuli and and its relationship to stress. Psychological Bulletin, 1973, 80 (4), 286-303.

It is almost axiomatic to assume that personal control over an impending harm will help to reduce stress reactions. However, a critical review of experimental research indicates that this assumption is not always warranted.

Specifically, three main types of personal control may be distinguished: (1) behavioral (direct action on the environment), (2) cognitive (the interpretation of events), and (3) decisional (having a choice among alternative courses of action). Each type of control is related to stress in a complex fashion, sometimes increasing it, sometimes reducing it, and sometimes having no influence at all. As a broad generalization, it may be said that the relationship of personal control to stress is primarily a function of the meaning of the control response for the individual. Stated differently, the stress-inducing or stress-reducing properties of personal control depend upon such factors as the nature of the response and the context in which it is embedded and not just upon its effectiveness in preventing or mitigating the impact of a potentially harmful stimulus.

Baade, E., Ellertsen, B., Johnsen, T. B. & Ursin, H. Physiology, psychology, and performance. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

In this chapter we will discuss the interaction between the physiological and psychological variables. At least some of the variance in the physiological responses must depend on psychological factors such as general abilities, defensive strategies, and the motivation for completing the training. The physiological changes taking place in the individual were presumably dependent on the psychological state. However, there was also a feedback principle working; the physiological changes in themselves may have contributed to the experience of the situation for each man. The perception of these bodily changes was probably affected, for instance by defense mechanisms, and these mechanisms probably did not only influence the perception of the external world. The performance and, in particular, the subjective evaluation and expectations of performance were of major importance for the subjective experience of the situation. Therefore, performance was also reciprocally influenced by physiological factors . . . . The interaction between physiology and psychology variables may be regarded as a complex feedback system between the brain and and the rest of the body.

Baade, E., Halse, K., Stenhammer, P. E., Ellertsen, B., Johnsen, T. B., Vollmer, F. & Ursin, H. Psychological tests. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

The general conclusion from the study of the physiological variables was that it was not the physical situation itself that determined the physiological response. When the men met the same situation repeatedly, there was a dramatic reduction in the physiological response. The men reported reduced or eliminated subjective fear, and their performance gradually improved according to the instructors. This indicates that the men were coping with their new situation, and we have suggested that the reduction in the internal state should be regarded as the criterion for coping having taken place . . . . Our conclusions so far have been based mostly on group means. However, since the physiological response depended on the subject's evaluation of the

situation, there probably were important individual differences due to variations in psychological factors. This chapter deals with such individual differences and with some psychological characteristics of these men. We wanted to elucidate what type of men approached this school, why they joined the course, and what strategies they used when they developed their coping skills . . . . A large number of factors were relevant to the total motivational situation for the individual. This was true for each step--from application to the course, to standing at the top of the tower ready for each jump, to deciding to stay in the course despite hardships and dangers . . . . Our main hypothesis is that, when a man is in a threatening situation, it is not the objective situation or his performance that determines the internal state. No matter how the man solves his problem, it is his own evaluation of his situation that is the important factor for determining whether or not coping will occur . . . . The consequences for studies of activation are that one must take these complex interactions into account. Performance, subjective experience of task difficulties, subjective evaluation of performance, subjectively experienced fear, and the defense mechanisms of each person all interact and determine the final internal state evident in a psychophysiological study of activation. In our opinion, this necessitates multidimensional analyses, and we have attempted to do this by descriptive factor analyses as our first approach.

Beaumont, G. & Mayes, A. Do task and sex differences influence the visual evoked potential? Psychophysiology, 1977, 14 (6), 545-550.

VEPs were recorded from each hemisphere of both male and female subjects at a parietal and a central site while concurrent spatial or verbal mental tasks were performed. The data were analyzed by means of an automated procedure for peak identification and each component's latency and amplitude was submitted to analysis of variance. No convincing task-hemisphere interactions were found, although several components, particularly the later ones, showed either task or hemisphere related effects. At both sites, females showed greater amplitude of the N2 component for both hemispheres and both cognitive tasks. Sex differences also emerged on components P6 and N6 which were consistent with the idea that females show differential hemisphere involvement in spatial tasks.

Beech, H. R. Learning: Cause and cure. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

There are, broadly speaking, two explanations offered to account for malfunctioning as a result of factors associated with one's occupation. The question, it seems, is not so much whether we are concerned with both the organism and the environment, but the degree of importance to attach to the former, the mechanisms to which the organism's sensitivity is responsive, and the degree of control we might come to have over such states. Posing such questions -- to which there are, as yet, no very satisfactory answers -- should not be construed as an attempt to dispose of the external environment as an important influence. It is merely that one must examine and

account for all elements which contribute to psychological breakdown and dysfunction. [Indicates] the importance of bringing the behavioral philosophy, methodology, and technique to bear upon the special problem of stress at work. In my view the adaptations necessary are minimal, and I have tried to indicate the broad lines along which one might proceed. In certain areas, such as systematic desensitization, self-control, social skills training, and so on, the case of the behavioural approach has obvious appeal. In certain other areas, as has been shown, there is greater uncertainty about both the mechanism involved and the relevance of application to work stress.

Beith, B. Work repetition and pacing as a source of occupational stress. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Work repetition and pacing have become increasingly common practices in industry for enhancing production efficiency. Questions have long been raised concerning potentially harmful stress effects of such job characteristics on the worker. A review of literature reveals indications of such stress; however, these have not corresponded specifically to any wide-spread ramifications evidenced in industry. This may be explained by the influence of system and individual moderators, as well as shortcomings in the literature and methodologies.

Bourne, P. G., Rose, R. M. & Mason, J. W. 17-OHCS levels in combat. Archives of General Psychiatry, 1968, 19, 135-140.

The findings in this study suggest the importance of group influences and assigned role in modifying the individual's adrenal cortical response to a stressful environment. In group situations where the possible alternative methods for handling stress are limited, the group factors tend to minimize the effect of individual differences. The observations made in the present study are highly consistent with [prior research]. It appears that . . . the higher levels of 17-OCHCS excretion shown by those in the leadership position is related more to their assigned role than specific personality factors and that they are responding to the demands imposed by the group rather than to the major threat in the external environment. The similarity of response seen in the other group members suggests that there is considerable conformity in the way any threat is perceived and in the manner in which it is handled. That the overall level of 17-OHCS excretion is relatively low implies that support from the group as well as individual psychological defenses and behavior patterns enable the man to perceive his environment in such a way that he reduces the very real threat of death or mutilation in combat.

Brett, J. M. The effect of job transfer on employees and their familes. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Bridger, H. The increasing relevance or group processes and changing values for understanding and coping with stress at work. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Broadbent, D. E. Decision and stress. New York: Academic Press, 1971.

There is a problem in the layout and presentation of a book such as this which the reader should perhaps consider. It arises from the rapid development of psychology and the tendency of the discipline to render out of date views put forward only a short time ago. The usual method of dealing with this problem is simply to state the view at the time of writing; but in this book we are going rather to show how the current view has arisen over the past ten years or so. In this way we may give an impression of the trend of the research and the direction in which it is moving, rather than merely a static picture of conclusions at one instant. In each chapter, therefore, there will be a chronological development rather than an axiomatic one.

Broadbent, D. E. & Gath, D. Symptom levels in assembly-line workers. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

This paper describes the results of surveys of mental health in two plants undertaking motor-car manufacture. In both cases, repetitive workers showed lower job satisfaction than non-repetitive ones; but not necessarily poorer health. Those who were paced by an assembly line, however, showed higher anxiety than those who were not; with no difference in job satisfaction. Cycle time, over the range found in these plants, bore no relation to health or to satisfaction [emphasis is the author's].

Bryden, M. P. Binaural competition and division of attention as determinants of the laterality effect in dichotic listening. Canadian Journal of Psychology, 1969, 23 (2), 101-113.

In the normal dichotic listening procedure, there is competition between 2 inputs arriving simultaneously. Also, S must attend to both ears at the same time. In a series of 4 experiments, with over 80 undergraduates, these 2 factors were manipulated independently to assess their relative contributions to the laterality effects. In the first 3 experiments, conditions were employed in which the input was always monaurally presented, but the S did not know in advance where the the material would arrive. In Exp. IV, the preinstruction condition provided a situation in which the S could direct his attention to a single channel. Results indicate that competition is both necessary and sufficient for a right-ear superiority to be observed. The necessity of attending to 2 channels at the same time does not seem to influence the laterality effect in any way.

Burke, R. J. & Weir, T. Coping with the stress of managerial occupations. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Caille, E. J. & Bassano, J. L. Biorhythm and watch rhythms: Hemeral watch rhythm and anhemeral watch rhythm in simulated permanent duty. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

The simulation of a 30-day submarine submersion with a volunteer crew of 24 men provided the framework for a comparison between two work/rest cycles within a crossover balance design: a 72- hour period rhythm, as practiced in the Navy, with 4 hours of sleep shifting or sleep splitting in cycic transposition for each third part of the crew; and a 24-hour period rhythm, with permanent 8 hours or 16 hours of sleep shifting for each third part of the crew. The strong advantage of the second alternative compared to the first is evidenced in the sleep process, behavioral efficiency, mood, and circadian biochemical parameters.

Cameron, C. A theory of fatigue. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Caplan, R. D., Cobb, S., French, Jr., J. R. P., Van Harrison, R., & Pinneau, Jr., S. R. Job demands & worker health (HEW Pub. No. (NIOSH) 75-160). Washington, D.C.: U.S. Department of Health, Education, and Welfare, National Institute for Occupational Safety and Health, April 1975.

Carriero, N. J. Physiological correlates of performance in a long duration repetitive visual task. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

This study examined the effectiveness of heart activity (HR), respiration (RESP), muscle activity (EMG), skin conductance (SCL), and brain wave activity (EEG) as discriminators of correct vs. incorrect performance in a repetitive visual task of approximately 2 hours' duration. Separate analyses were made of the data to distinguish the operation of task difficulty from performance accuracy. In addition, both of the analyses were repeated using standard score transforms of the raw data to compensate for individual differences. An interactive statistical design was employed to assess the differential changes of the physiological variables with accuracy over time. This design proved to be of crucial importance in assessing this relationship since the accuracy main effect for RESP, EMG, and HR was nonsignificant in all four data treatments. The accuracy-by-time interactions were significant in a number of instances and established the efficacy of these parameters as

discriminators of performance adequacy. Additionally, the standard score transforms proved essential to establishing these relationships when the variance in task difficulty was eliminated. The implication of these findings for the development of an alertness indicator is also discussed.

Carriero, N. J. & Gehringer, E. C. An annotated bibliography of the literature dealing with the physiological correlates of attitudes and attitude change. Aberdeen Proving Ground, MD: Aberdeen Research & Development Center, Human Engineering Laboratories, December 1971.

Carroll, D. Physiological response to relevant and irrelevant stimuli in a simple reaction time situation. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Carroll, J. C. Technology and job pressures. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis Ltd, 1981.

A review is given of the introduction of new technology by the Bell System during the 1970's and of its effects on various components of the workforce.

Carruthers, M. Hazardous occupations and the heart. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Chesney, M. A. & Rosenman, R. Type A behaviour in the work setting. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Childs, J. M. & Halcomb, C. G. Effects of noise and response complexity upon vigilance performance. Perceptual and Motor Skills, 1972, 35, 735-741.

Visual vigilance performance was investigated with respect to environmental stimulation (90 db, 1000 cps noise) and intra-organismic stimulation (*simple vs complex response*). 140 Ss monitoring a display for 1 hour under 1 of 2 noise types were instructed either to press a button upon detection of aperiodic signals (simple response) or to perform also a checklist operation subsequent to the signal detection (complex response). Significant correct detection differences occurred between response groups with complex groups showing higher performance. Differences in correct detection were obtained

for noise conditions (for continuous, $\underline{M}$ = 83%; for intermittent, $\underline{M}$ = 78%). Results were evaluated in terms of the activation period.

Chiles, W. D., Workload, task, and situational factors as modifiers of complex human performance. In E. Alluisi & E. A. Fleishman (Eds.), Human performance and productivity: Stress and performace effectiveness. Hillsdale, NJ: Lawrence Erlbaum, 1982.

It should be remembered that workload, task, and situational factors are in fact highly interrelated. Workload cannot be meaningfully discussed in any practical application without reference to the number and characteristics of the individual tasks of which the job is comprised, and similar consideration must be given to the situational and procedural constraints that are attendant to the job. The primary concern in this chapter has been with complex human performance as it occurs in the real world of work. The intent has been to suggest methods whereby measurements that will be relevant to that real world can be made and to offer suggestions as to some important factors that must be considered in the design of research on complex performance and in the interpretation of findings therefrom.

It is an unfortunate, but inescapable, fact that a body of established, reliable data does not exist in this area of the behavioral sciences. Most of the published laboratory research findings on tasks like those found in operational systems have little or no potential relevance, because the data were collected with the tasks being performed alone, as single tasks by themselves without time-sharing requirements. The most critical problem encountered in the conduct of research on the kind of complex human performance that is of relevance to operational systems is the criterion problem. Simply, too little is known on how to measure human performance in operational systems, or even on how to measure the performance of systems, except in the simplest cases and there only in a very gross manner. The need for the development of methodology in this area has long been recognized, but, for a variety of reasons, it has not been possible to mount a concerted attack on the problem, and the minor efforts expended to date have failed to yield very impressive gains . . . . The criterion problem is both too large and too profound to be overcome by mere brute force, even the force of masses of data collected and analyzed from simulated and operational-system studies. It is more likely that appropriate guidelines from carefully designed programmatic laboratory research on workload, task, situational, and other factors as modifiers of complex human performance will be needed to identify the promising lines of attack. Such programmatic research is not widely in evidence at present.

Coates, G. D. & Kirby, R. H. Organismic factors and individual differences in human performance and productivity. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

In order to keep the chapter within reasonable bounds, it has been necessary to limit the coverage to a restricted set of organismic and individual-difference variables. Specifically, only those genotypically determined individual-difference variables that affect human performance and productivity have been reviewed -- namely: (1) sex differences; and (2) aging processes. In addition, the topic of race differences is discussd briefly in a later section. Individual differences in abilities, skills, personality, interests and other human characterisitics have beeen dealt with in another volume in this series . . . . Likewise, only those nonmomentary changes in the physical state of the organism that are, at least potentially, relevant to human performance and productivity have been included among the orgaismic variables reviewed -- namely, the effects of: (1) health and illness; and (2) handicaps and physical defects. The effects of toxic substances could have been included within these review guidelines, but the topic has been omitted because it has been recently covered very well elsewhere.

Cohen, A. Human factors methodology for stress evaluation in machine-paced jobs: some NIOSH experiences. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Procedures for examining machine-paced job demands and related work conditions in terms of their stress-producing effects upon worker health and wellbeing are described based on NIOSH research. Among those presented are questionnaire surveys intended to define psychological stressors and strains, on-site observations with checklists to focus on work-station/environmental/equipment/work-process factors of concern, and task analysis and modelling techniques to characterize the physical demands imposed and means for their alleviation.

Cohen, B. G. F., Smith, M. J. & Stammerjohn, Jr. L. W. Psychosocial factors contributing to job stress of clerical VDT operators. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis Ltd, 1981.

As a consequence of escalating complaints by video display terminal (VDT) users, the potential health effects associated with VDT use were investigated at five worksites by the National Institue for Occupational Safety and Health (NIOSH). Respondents included: (1) clerical workers using VDTs at either a newspaper or insurance company; (2) clerical workers not using VDTs; and (3) professional newspaper staff using VDTs. This chapter discusses psychosocial factors which could either allay or contribute to job stress of the three groups. The group experiencing the largest amount of job stress and health complaints, clerical VDT workers (CVS), are the

primary focus of discussion. CVS' jobs are akin to machine- paced assembly lines in manufacturing plants in the sense that they involve minimal control over tasks or workpace, boring, repetitive tasks, work overload, close monitoring by supervisors, and fear of being downgraded or replaced by the VDT. Controlled studies examining clerical jobs are necessary. NIOSH is planning such field and laboratory studies.

Cohen, S. Aftereffects of stress on human performance and social behavior: A review of research and theory. Psychological Bulletin, 1980, 88 (1), 82-108.

A review of correlational and experimental studies of the aftereffects of stress on performance suggests that these effects occur as a consequence of a wide range of unpredictable, uncontrollable stressors including noise, electric shock, bureaucratic stress, arbitrary discrimination, density, and cold pressor. These effects are not limited to a restricted range of stressful situations that involved a lack of predictability and controllability over a distracting stimulus . . . they can be induced by increased task demand. Interventions that increase personal control and/or stressor predictability are effective in reducing poststressor poststimulation effects on social behavior that generally involve an insensitivity toward others following stressor exposure. Studies of exposure to environmental stressors in naturalistic settings report effects similar to those found in laboratory settings. Several theories (e.g., psychic cost, learned helplessness, arousal) are examined in light of existing evidence. Although some theories receive more support than others, it is suggested that the reliability and the generality of poststimulation effects occur in part because of a multiplicity of causes.

Cooper, C. J. Anatomical and physiological mechanisms of arousal with special reference to the effects of exercise. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Cooper, C. L. & Marshall, J. Sources of managerial and white collar stress. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Life in complex industrial organizations can be a great source of stress for managers. Managers are suffering extreme physiological symptoms from stress at work, such as disabling ulcers or coronary heart disease (CHD), which force them to retire prematurely from active organizational life before they have had an opportunity to fully actualize their potential. These and other stress related effects (e.g., tension , poor adjustment, etc.) also feed into the family, becoming potential sources of disturbance and thus pervading the whole quality of life of the individual. The mental and physical health effects of job stress are not only disruptive influences on the individual manager, but also a 'real' cost to the organization, on whom many

individuals depend: a cost which is rarely, if ever, seriously considered either in human or financial terms by organizations, but one which they incur in their day-to-day operations. In order to do something positive about managerial stressors at work, it is important to be able to identify them. A recognition of the possible sources of management stress, therefore, may help us to arrive at suggestions of ways of minimizing its negative consequences. It was with this in mind that we decided to bring together the research literature in the field of management and organizational stress in a framework that would help us to more clearly identify sources of stress on managers.

The framework offered in this chapter is basically an attempt to integrate the findings of new research. Much of this work will be in the field of managerial stress. A study of the literature reveals a formidable list of over 40 interacting factors which might be sources of managerial stress--those to be dealt with here were drawn mainly from a wider body of theory and research in a variety of fields; medicine, psychology, and management sciences.

Cooper, C. L. & Payne, R. (Eds.) Stress at work. New York: John Wiley, 1978.

Cooper, C. L. & Payne, R. (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Cortical evoked potentials associated with learning and cognitive processes (SSIE DK13-97). Washington, D.C.: Smithsonian Science Information Exchange, July 1979.

Several proposed research projects on EEGs and "attention"; both human and animals.

Cox, T. Repetitive work. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Cumming, R. W. & Croft, P. G. Human information processing under varying task demand. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Dashkevich, O. V. Experimental analysis of conditions for appearance of emotional stress. (Russ) Zhurnal Vysshei Nervnoi Deyatel'nosti, 1973, 23 (3), 538-544. (English summary). [54-11052 PA]

Results show that stress is intensified with a rise in pragmatic uncertainty which sets in when even more difficult goals are set as a long term goal is about to be achieved. The complexity of the structure of the emotional state, in which the intensity of an individual function is but one essential parameter, is emphasized.

Davey, C. P. Physical exertion and mental performance. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Davidson, J. M., Smith, E. R. & Levine S. Testosterone. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

[Plasma testosterone levels showed a "profound" drop beneath basal levels after the first jump with elevated levels following all other jumps, and declining plasma testosterone levels during each 20-minute post-jump period. It was concluded that testosterone suppression on the first jump was in response to the severe apprehension experienced in the hours previous to the jump.]

Davidson, R. Functional asymmetry in the brains of men and women. Paper presented at Harvard, March 3, 1981. (Received from J. T. Lester, ONR, Boston)

[Discussed functional asymmetry in the brain with particular attention paid to differences in data obtained from males and females.] Without detailing the somewhat complex results, sex differences did indeed appear, both in trainability and in the correlates of the different patterns of cortical activity. [Hypothesizes that] females have a greater capacity than males to minimize "cross-talk" betweem cerebral hemispheres when it is efficient to do so (when the task at hand is best handled by a specific half of the cortex), and, as a corollary, that females have greater bilateral flexibility in relation to carrying out tasks. Where a task such as verbal comprehension or the interpretation of facial expression is best controlled by one side of the brain, females are likely to excel; where a task can be handled equally well by either side, either there should be no superiority or males should excel.

Davies, D. R. & Parasuraman, R. Cortical evoked potentials and vigilance; A decision theory analysis. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Studies of the psychophysiological concomitants of vigilance performance are briefly reviewed. It is suggested that performance assessment has been inadequate or incomplete in the majority of these studies and that it would be profitable to utilize measures derived from statistical decision theory, particularly in relation to indices of cortical activity, in studies of vigilance. The evoked potential (EP) is then described and research relating late EP components to decision processes is outlined. The few experiments that have examined EPs in relation to vigilance performance are examined and suggestions for further research are made. These are implemented in two experiments on vigilance, the first concerned with the effects of events rate and signal regularity on measures of EP amplitude and of vigilance and their associated EP component latencies. It is concluded that both late amplitude and latency measures of the EP are significantly related to (1) within-session performance changes, (2) differences in response latency associated with different response categories, and (3) the effects of independent variables such as event rate and signal regularity. In the last part of the paper a model is outlined in which both speed and accuracy measures of vigilance performance can be incorporated within a decision theory framework, and some preliminary results suggesting that EP late components provide correlates of decision processes in vigilance are discussed.

Dawson, S. L., Tucker, D. M. & Swenson, R. A. Lateralized cognitive style and self-description bias (manuscript in preparation). Grand Forks, ND: University of North Dakota, Dept. of Psychology, 1982.

This research examined whether a normal cognitive style suggestive of greater reliance on one cerebral hemisphere's cognitive processing would be associated with a characteristic emotional orientation. A descriptive factor analysis of a batterty of personality and cognitive measures showed that the major factor that included both cognitive and affective measures received loadings from scales indicating self-repot bias. The loading of the whole-to-detail ratio from the Rorschach inkblot test on this factor indicated that persons who responded to whole rather than details tended to describe themselves favorably. In a second study, subjects endorsing questionnaire items thought to reflect a cognitive style involving greater right than left hemisphere usage obtained a profile on an emotion inventory suggesting that they were less depressed, more trustful, more impulsive, and described themselves in more positive terms than those with a more left hemisphere style. These self-report biases of normal students with laterialized cognitive styles seem to parallel the self-report biases of left and right temporal lobe epileptics.

Dimond, S. J. Vigilance and split-brain research. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

In the attempt to find systems of the brain responsible for vigilance performance, it is shown in studies of the capacity of the normal person that the watchkeeping functions at the two sides of the brain differ in certain important respects. The view is expressed that there are two different hemisphere vigilance systems of the brain. This has important implications for theories of vigilance because theory which applies to one may not apply to the other. Studies of split-brain man show differences between the performance of the two hemispheres and in addition reveal gross failures of vigilance performance associated with the total-split condition but not with partial section preserving the splenium. The defect can be characterized as "holes of consciousness," appearing at each side of the brain. The view is expressed that the system which itself unifies the two hemispheres acts as part of the system for visual consciousness which spans the brain and involves the splenium of the corpus callosum.

Drury, C. G. & Coury, B. G. Stress pacing, and inspection. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Stress is shown to affect performance on inspection-like tasks and inspection tasks are shown to be stress-producing. The speed stress of pacing in a search-dominated inspection task is considered analytically, where it is shown that unpaced performance is superior to paced performance. A model of the inspector as a resource-limited information processor is used to develop a methodology for the study of stress in inspection.

Dumas, R. & Morgan, A. EEG asymmetry as a function of occupation, task and task difficulty. Neuropsychologia, 1975, 13 (2), 219-228.

Artists and engineers were tested for asymmetry of occipital alpha as a function of occupation, lateral specificity of task, and difficulty of the task. Nebes' ring test and a facial memory test were used as "right hemisphere" tasks, and linguistic and mathematical tasks were chosen as "left hemisphere" specific. Results found no difference on the basis of occupation or difficulty, and significant results were found for task laterality.

Edwards, L. Pilette, S., Biggs, B. & Martinek, H. The effect of workload on performance of operators monitoring unattended ground sensors. ARI, 1978.

Eide, R. & Atteras, A. Blood glucose. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

The nervous system is entirely dependent on glucose for fuel. Little research has been done on the role of blood glucose in man under stress. In diabetic patients, emotional stress increases circulating glucose, which may explain the importance of emotional factors in patients with diabetes mellitus . . . . There seems to be a feedback loop between blood sugar level and the catecolamine-regulating centers in the hypothalamus . . . . In the present study an increase was predicted in both catecholamines and glucocorticosteroids during parachute jump training and that this increase would be reduced as a function of repeated exposure. We further predicted that blood glucose would follow the same pattern and that the severity of the acute stress would tend to override a negative feedback of glucose on catecholamines so that glucose would be positively correlated to catecholamines as well as to cortisol . . . . As predicted, blood glucose clearly increased in the stress situations compared to the basal value, and this increase tended to be reduced as a function of training. Unexpectedly, we found a slight increase in glucose on the last sample day. This might have been due to some apprehension in the subjects due to the approaching final jump examination.

Elias, M. Police get help coping with stress. Los Angeles Times, Part V, Wednesday, June 10, 1981.

Elfertsen, B., Johnsen, T. B. & Ursin, H. Relationship between the hormonal responses to activation and coping. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

In a situation with repeated exposures to a threatening situation, coping can be said to have taken place when there is a reduced physiological response to the threat. Most physiological processes seem to be involved in the response to psychological threats through the "activation" process. This is true for autonomically innervated organs, studied in the classical psychophysiological experiments, and it also seems to be true for a wide variety of endoctrine processes. Therefore, one might expect that it would suffice to follow only one of these hormones or somatic processes, using this as an indicator of the internal state . . . . However, hormone systems seem to be less readily subject to selective classical or instrumental control, and, in particular, there is no evidence of discriminative control . . . . Because we followed activation over time, from basal level to a high level of activation and then to a gradual reduction back to basal levels, we should be able to observe differences in intercorrelations between the indicators depending on the activation level. The whole physiology matrix was therefore examined for correlations and factor patterns . . . . The group data reviewed in the previous chapters tell a very consistent story. There was a clear activation after the first jump, and all variables monitored pick up this activation. There was then a gradual coping process that reduced most of the variables. This strongly suggests the presence of one or two underlying mechanisms that influence the physiological processes monitored.

Ellis H., A. What people can do for themselves to cope with stress. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

[A description of rational-emotive therapy (RET)].

Ewing, L. Preliminary input data and user's manual for behavioral security model (MRC-R-650). Santa Barbara, CA: Mission Research, July 1981.

Ferguson, D. A study of occupational stress and health. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Fiskel, J. R. & Bower, G. H. Question-answering by a semantic network of parallel automata. Journal of Mathematical Psychology, 1976, 13, 1-45.

Human semantic memory is modeled as a netowrk with a finite automation embedded at each node. The nodes represent concepts in the memory, and every arc bears a label denoting the binary relation between the two concepts that it joins. The process of question-answering is formulated as a mathematical problem: Given a finite sequence of lablels, find a path in memory between two given nodes whose arcs bear that sequence of labels. It is shown that the network of automata can determine the existence of such a path using only local computation, meaning that each automaton communicates only with its immediate neighbors in the network. Furthermore, any node-concept along the solutin path can be retrieved. The question-answering algorithm is then extended to incorporate simple inferences based on the equivalence of certain sequences of relational lables. In this case, it is shown that the network of automata will find the shortest inferable solution path, if one exists. Application ofthese results to a semantic corpus is illustrated.

The two semantic topics of negation and quantification receive special treatment. Careful study is made of the network structure required to encode information relating to those topics and of the question-answering procedures required to extract this information. The notions of a negated relation and a negated question are introduced, and a negation-sensitive path-searching algorithm is developed that provides for strong denials of queries. For sentences involving universal and existential quantifiers, it is shown how the terminal can translate a first-order language question into a sequence of network queries. In both areas, the network model makes reaction-time predictions that are supported by several experimental findings. Extension of the model that would permit the encoding and retrieval of propositional information are mentioned.

Folkman, S., Schaefer, C. & Lazarus, R. S. Cognitive processes as mediators of stress and coping. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

There is mounting conviction, and evidence from laboratory, clinical and field investigations, that the ways people think about a stressful situation affect how they respond emotionally and how they cope. The rapid growth in cognitively oriented approaches to the emotional and motivational aspects of adaptation . . . has even been referred to as the 'cognitive revolution' in psychology . . . although Bolles (1974) holds that psychology has always been cognitive in orientation except for a seventy-year recent period of aberration. If we include in this the cognitive behaviour therapists . . . the crescendo of interest in cognitive issues in stress, coping, and adaptation cannot be denied . . . . A wide gap exists, however, between those who look at cognitive processes as a potential guide to understanding individual differences in stress responses and those who are concerned normatively with the cognitive processes involved in information processing.

Fontaine, C. W. The relationship between catecholamine excretion as a measure of psychological stress and the variables of job performance and gender. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Fifteen males and 15 females worked for 5 days in a simulated work environment. Physiological changes in the form of greater excretion of both epinepherine and norepinephrine were found, although the increase of norepinephrine was not statistically significant. Performance on the cognitive, data interpretation and utilization, and motor aspects of the complex man-machine task were all found to be facilitated up to a point, but then impaired as the stress level intensified. Perceptual functioning showed no effects of stress. Females, when compared to males, showed a much less severe phsyiological response to the psychological stress, while performing all tasks with the same efficiency. The results indicate that an inverted-U relationship exists between physiological responses to psychological stress and job performance.

Forsyth, G. A. & Huber, R. J. Selective attention in ambiguous-figure perception: An individual difference analysis. Bulletin of the Psychonomic Society, 1976, 7 (6), 498-500.

Presented 10 human vs nonhuman ambiguous-figure stimuli for identification to 200 elementary, 100 high school, 100 university and 120 inpatients at a state hospital. Findings illustrate the usefulness of the individual difference approach to the study of ambiguous-figure stimuli.

French, Jr., J. R. P. & Caplan, R. D. Organizational stress and individual strain. In D. W. Organ (Ed.) The applied psychology of work behavior: A book of readings. Dallas, TX: Business Publications, 1978.

Geddes, L. A. Physiological monitoring in the workplace. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

In assessing stress it is customary to select those physiological events that are altered by environmental stimuli. In a laboratory setting the constraints are not too severe. However, in the workplace it is necessary to make a trade-off between those events that are desired and the events that are easily acquired, without hampering the worker in his task. A good principle to employ is 'maximum information from the minimum number of attachments to the subject'. With this as a guideline, a system has been developed to acquire heart rate and its instantaneous change, respiration rate and depth and blood pressure, obtained non-invasively. This system has been used in an industrial setting to monitor workers on an assembly line.

The method of obtaining heart rate, it's beat-by-beat change, respiration rate and depth, requires the application of two small electrodes to the lateral chest wall. These two electrodes simulate lead 2 electrocardiogram (ECG) and provide a large amplitude R wave in most subjects. The R wave is bandpass-filered and fed into a counter to indicate mean or instantaneous heart rate. Respiration is detected by continuous measurement of the impedance change between the two ECG electrodes. A 25 kHz, constant current (50 Mega Amps) is passed throug the subject. The impedance change is processed to provide an analog output which displays rate and depth of breathing.

Giannitrapani, D. Scanning mechanisms and the EEG. Electroencephalography & Clinical Neurophysiology, 1971, 30 (2), 139-146.

It is suggested that there is a hierarchy of scanning mechanisms beginning with alpha activity scanning for any stimulation. Its function ceases or subsides in the presence of a broad range of percepts, whether internal or external. At this point in the perceptual cycle, faster scanning mechanisms occur, such as beta activity in the temporal areas, scanning for structure. This activity subsides just as alpha activity does when the conditions for its existence are no longer present. Beta activity disappears when the stimulus has acquired the necessary structure. The existence of faster mechanisms to mediate even more complex processes is discussed.

Goodyear, M. D. E. Stress, adrenocortical activity and sleep habits. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Gowler, D. & Legge, K. Evaluative practices as stressors in occupational settings. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Hackman, J. R. Tasks and task performance in research on stress. In J. E. McGrath (Ed.) Social and psychological factors in stress. New York: Holt, Rinehart & Winston, 1970.

Haider, M., Koller, M., Groll-Knapp, E., Cervinka, R. & Kundi, M. Psychophysiological studies on stress and machine-paced work. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Occupational stress in machine-paced work is characterized by a combination of monotony and different degrees of mental load. In a series of laboratory and field studies we demonstrated that these combined stressors of boredom and compensatory efforts may lead to different desynchronizations of functions and dysregulations within functional systems [emphasis is the author's]. In laboratory studies we pursued the flucuations and decline of vigilance performance as well as 'cerebral vigilance' by means of EEG frequencies, evoked potentials and slow brain potentials, together with opposed trends of muscle tension (increasing microtremor frequencies) and skin potential responses.

In field studies we found higher pulse rates and longer reaction times in 'secondary tasks' for groups of workers with paced assembly-line work as compared to control groups with self-paced work. This was mainly true at the beginning of working spells, probably caused by the pacing rhythm being especially unphysiological at the onset of work. The dysregulation within the circulatory system was characterized by relatively high pulse rates during machine-paced work, accompanied by relative low systolic blood-pressure values.

Hall, D. T. & Hall, F. S. Stress and the two-career couple. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Hall, R. J., Caldwell, J., Solomonson, D., Weaver, R. & Hanna, W. Security personnel performance measurement system - Phase I Literature search and data collection design. Mission Research Corp., 1979.

Hall, R. J., Hanna, W., Weaver, R. & Benner, P. Security personnel performance measurement system: Vol. I Overview of Phase II results and recommendations. Mission Research Corp., 1979.

Hall, R., Hanna, W., Weaver, R., Benner, P., Solomonson, D. & Caldwell, J. Security personnel performance measurment system. Vol. II--An extended discussion of phase I procedures, results and recommendations (MRC-R-513). Santa Barbara, CA: Mission Research, August 1979.

Phase II of the Security Personnel Performance Measurement Program comprehensively surveyed two Army CONUS sites. A total of 174 guard force pesonnel were interviewed on duty (including officers and NCO's). Data were also collected on site characteristics, security equipment, and systems and operational procedures. Data analysis supports the hypothesis that lack of a performance product, boredom, and poor motivation contribute to marginal performance and low expectations for coping with a security emergency. Based on the hypothesis, enhancement programs are suggested.

Hall, R. J. & Mackie, R. R. Security system operational recording and analysis Phase I report (CRG TR-81-008), March 1981 (Secret).

Halse, K., Blix, A. S., Ellertsen, B. & Ursin, H. Development of performance and fear experience. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Hamilton, V. Human stress and cognition: Problems of definition, analysis, and integration. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979. (a)

The accumulation of studies and models of the nature and components of adaptive cognitive processes seems to have reached the stage at which a first tentative synthesis of their interaction may be usefully attempted. The concepts which are likely to make such an attempt profitable should be derived . . . from analyses of human cognitive processes and capacities, and from the recent fast growth of knowledge of the influence of neurotransmitters on speed and organization of attentional and response integrating events. Furthermore, the concepts should be in terms of information processing capacities and strategies. This volume, therefore, has four general aims: (1) to present an up-to-date picture of the basic concepts of stress, information processing models, and physiological models of their interrelatedness; (2) to review the present status of experimental work in psychology on the interaction between stress and the major areas of cognitive functioning; (3) to consider the major areas of human functioning in which stress is assumed to play a role or to be induced, from the standpoint of human information processing operations and strategies; and (4) to apply the same conceptual approach to the analysis of two major psychopathological disorders, and their development.

Hamilton, V. Information processing aspects of neurotic anxiety and the schizophrenias. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979. (b)

A volume on human stress and cognition would be incomplete without reference to the ten or twelve percent of the unselected population who are unable to lead a life free from severe strain and the incapacities associated with it. In this chapter, therefore, and in the next one, we shall consider neurotic anxiety states and the schizophrenias as extreme examples of the effects of stressors on behaviour. The present chapter, however, will be entirely devoted to a cognitive analysis of neurotic anxiety and schizophrenia and will refer only peripherally to the role of physiological and pharmacological stressors. The one exception will be a critical assessment of the role of arousal in behavior disorders . . . . The unusual plan of discussing anxiety and schizophrenic disorders under one heading will be defended in subsequent pages by a model derived from experimental work with normally and neurotically anxious children and adults, and from experimental and applied studies of chronic schizophrenic men. After discussing some cognitive processing deficits found in association with neurotic anxiety, I shall present an information processing interpretation of neurotic deficit. This will constitute an elaboration of an information processing model of anxiety which has now gone through several modifying stages. I shall then discuss some cognitive processing deficits in schizophrenia. Finally, and with reference to developmental antecedents, I shall apply the information processing model of anxiety to schizophrenic behaviour in an experimental and a natural setting. The proposition is that anxiety may be the most important single factor in the development of schizophrenic conditions . . . . I shall argue that neurotic anxiety is excessive aversive and/or threatening information. This information resides in cognitive data which encode in schemata an individual's expectancies and anticipations of pain, rejection, isolation, and personal incompetence . . . . The structure of aversive schemata, and their role in analysing stimulus input is analogous to the function of schemata in remembering (Bartlett, 1932; Neisser, 1967), and in perceiving (Vernon, 1955). They provide a relatively coherent and consistent predisposition of the environment. This predisposition has a strong developmental foundation.

Hamilton, V. Personality and stress. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979. (c)

The aims of this chapter are tentatively idealistic: to search for a set of explanatory principles of personality and stress which will reflect recent advances in the experimental methodology applied to cognition and the new hypothetical constructs or paradigms which have emerged from them. What seems to be required is a redescription and reconceptualization of what we mean by the time-honoured concept of personality and what actually constitutes psychological stress. A restatement, particularly of their unobservable components, must at the same time satisfy the structural, functional, and logical requirements of processes and behaviors which are known to interact.

In successive sections of this chapter, I will attempt to cite and interpret data which appear to be consistent with a cognitive, information processing analysis of personality characteristics and of stress. It is more than likely that this goal is premature and, therefore, over-ambitious, because it is tied to constructs and paradigms which may be superseded shortly. Since I am aware of my goal, and of my anxiety at exposing myself to academic criticism and even ridicule, and since the task is daunting, I am aware of the stressors and the strain. Awareness, however, requires knowledge of information which can only be communicated by cognitive data and the processes which manipulate them.

Hamilton, V. & Warburton, D. M. (Eds.) Human stress & cognition. New York: John Wiley, 1979.

Stress is a universal and frequently disabling human phenomenon, and this volume presents a first synthesis between cognitive theories of information processing and the causes and components of stress. Psychological research can be relevant for behavior outside the laboratory, and this is demonstrated in this book by the reports of research into new methods of stress prevention and understanding. From the collaboration between authors from disciplines which rarely interact . . . the editors have endeavoured to generate a new interpretation of stress, stressors, and strain in the hope that it may lead to a more fundamental level of understanding.

Handy, C. The family: Help or hindrance? In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Is the family a source of stress at work, as the placing of this chapter suggests, or a way of alleviating it? Is the family a help or a hindrance? Or, looking at it the other way round, is work a help or a hindrance to the family relationship? Does, for instance, the dominating work role of one partner (often the husband) mean that the other partner has to subordinate his or her true interests? There is a growing body of writing and research on this relationship between work and family, reflecting perhaps the facts that something like 90% of those who work, work in organizations, that over half of married women today do work outside the home and even more intend to do so, and that the family, so far from declining as a social institution is probably growing in importance even if its forms and norms are changing.

Hansen, J. R., Stoa, K. F., Blix, A. S. & Ursin, H. Urinary levels of epinephrine and norepinephrine in parachutist trainees. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

[The post-jump values of epinepherine and pre- and post-jump values of norepinepherine did not drop below the basal level. Recorded levels of these measures were always higher (usually significantly higher) on the first jump day.]

Hatta, Takeshi. Functional hemispheric asymmetry in perception of random forms. The Japanese Journal of Psychology, 1975, 45 (5), 152-161.

Two experiments were conducted in which Ss made the "same-different" judgement with respect to a pair of random forms which were serially presented to the right and the left visual fields tachistoscopically. In Exp. 1 the stimulus materials were random forms painted solidly, and in Exp. 2 they were contour forms. The major results of both experiments were essentially the same. The results indicated that right VF-lead condition produced more errors than the left VF-lead condition, and that the high complexity form group produced more errors than the low complexity form group. The tendency of left VF-lead superiority was more pronounced when the interval between the two stimuli was longer. These results suggest the possibility of the right hemisphere's superior function concerning the perception of random forms.

The results of both experiments could be interpreted by the following hypothesis: Information value or an increase in the amount of interference will decrease less rapidly in the superior hemisphere as time elapses. Therefore, if one hemisphere, superior in perceiving random forms, initially receives visual information concerning a standard stimulus, and the other hemisphere received comparison stimulus information only subsequently, the accuracy in the "same-different" judgement will be superior in this condition than in the reverse order condition. Consequently, if the right hemisphere is superior for the perception of non-verbal materials, the condition in which the hemisphere initally received the information will make less error judgements than the reverse order condition. Hence the results demonstated in both experiments suggest the possibility of right hemisphere superiority for the perception of non-verbal materials.

Hatta, Takeshi. Functional hemispheric asymmetries in perception of digit and line orientation. The Japanese Journal of Psychology, 1976, 47 (5), 268-276.

In Exp. 1, right-handed Ss made the "same" or "different" judgement to paired digits serially presented to the right and left visual field, and exhibited erroneous judgements in the left visual field lead condition. These results suggest the left hemisphere superiority. In Exp. 2, the Ss were requested to make the "same" or "different" judgement and to press a key as

fast as possible to the paired line orientation. The right visual field lead condition produced more errors than the left visual field lead condition. This suggests the right hemisphere superiority. But no difference appeared between both conditions in the reaction time. The opposite hemispheric superiority, found in perceiving verbal and non-verbal materials in both experiments, would be attributed to the basic difference in "perceptual" process. The overall results in this study suggest that not only the "memory process" as shown in previous studies, but also the "perceptual process" contribute to the effects of hemispheric differences in the recognition of verbal and non-verbal materials.

Hockey, R. Stress and the cognitive components of skilled performance. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

The aims of this chapter are twofold; firstly, to attempt an integrated survey of research findings in the area of stress and performance and, secondly, to propose alternative methodological and theoretical approaches to the experimental study of stress effects in cognition. In reviewing the literature I have concentrated on two main areas of skilled performance, sustained attention and memory. This is primarily because most work has been done in these two fields and the findings are therefore more reliable. In addition, however, and this may be no accident, these two components may be considered as, in some ways, primary in the orgainization of skilled behaviour.

Hogan, R. & Hogan, J. C. Subject correlates of stress and human performance. In E. A. Alluisi & E. A. Fleishman (Eds.), Human performance and productivity: Stress and performance effectiveness. New Jersey: Lawrence Erlbaum Associates, 1982.

This chapter offers an overview of theory and research regarding subjective or psychological factors in stress and their influence on human performance. The stress literature is extensive and complex, extending through fields as diverse as clinical and applied psychology, anthropology, sociology, psychosomatic medicine, industrial relations, and epidemiology. The chapter is organized into six major sections following this introduction. The first is concerned with definitions; the second reviews influential theories of stress. In the third section, we summarize what we regard as a set of valid generalizations that can be drawn from the extensive modern literature. The fourth section offers some specific criticisms of contemporary stress research. Drawing on these theories, generalizations, and criticisms, the fifth section outlines a theoretical perspective that has potential for integrating much of the existing stress literature. Finally, we offer a summary and some recommendations in the sixth section.

Horowitz, M. J. Psychological response to serious life events. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

One of the great paradoxes of the mind is that it must use existing inner models to interpret new events; models based on the past must interpret the present and be revised to meet the future. Evolution and development have favoured the best balance between retention of earlier forms and the acceptance of new stimuli. But the equilibrium between old forms and new information is not easily or quickly balanced when present events are those of loss. This chapter discusses psychological responses to those serious life events that involve loss, either of a part of the self, or of others; of a world as it once was.

An ideal adjustment to loss, having done what one can to prevent it, is to accept it, to replace that which is lost, and to go on living. But there is an important, painful interval between the first pangs of recognition of loss and adaption to circumstances as they must be. During that interval, there are states characterized by unusual levels of both intrusion of ideas and feelings and denial of ideas and numbing of emotions. Underlying these shifts in state are changes in inner models of the self, others, and the world; some due to alterations in dominance among models, and others due to formation of new models. Such changes are based on a gradual processing of the new information.

These aspects of psychological response can be systematically studied in any group of persons who experience major life events, and the resulting theory may help in planning the most humane support and treatment for those who experience intense responses to stress.

Horowitz, M. J., Becker, S. S. & Malone, P. Stress: Different effects on patients and nonpatients. Journal of Abnormal Psychology, 1973, 82 (3), 547-551.

Tested the hypothesis that psychiatric patients have, in general, either a heightened susceptibility toward entry into a state of stress or less control over stress response tendencies than nonpatients. 28 inpatients with diagnoses in the range of neuroses and character disorders were contrasted with 44 nonpatient controls of similar sex, age, education, and career status. Both groups saw a stress film. Before and after the film, they performed a signal-detection task and gave episodic reports of their mental contents. The psychiatric Ss reported significantly higher levels of fear and nervousness and, in the poststress condition, had significantly higher levels of intrusive and stimulus-repetitive thought.

Hoyos, C. G. Demands and stress in supervisory tasks: Observations in railroad traffic control centres. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis Ltd, 1981.

The main aim of this investigation was to assess the mental load of job incumbents such as station agents in railway systems and to find out if mental load may impair cognitive functions and initiate human errors. The PAQ was in our opinion the procedure best suited to identify ing in detail demands at the workplace of station agents and to making assumptions about strain of operators. To verify these assumptions, a number of operators were asked to evaluate task elements with respect to strain experienced. This has been done under three aspects: intensity, duration and subjective control. Events at work should be more stressing with increasing intensity and duration and if they are out of control of the operator. Comparisons between ratings by job analysts and evaluations by job incumbents showed a fairly good agreement with respect to stress potential of work conditions.

Hurrell, Jr., J. J. & Smith, M. J. Sources of stress among machine-paced letter-sorting-machine operators. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Sources of job stress among some 3000 machine-paced letter-sorting-machine operators were examined via a questionnaire survey. It was found that one of the major sources of stress for these workers was task dissatisfaction. Perceiving the task . . . to be boring and to lack both challenge and interest was associated with a number of negative psychological and physical states [emphasis is the author's].

Johansen, R. Stress and socio-technical design: A new ship organization. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Stress seems to develop when there is a substantial imbalance between the task an individual faces and his ability or means to complete it. Work and life at sea are marked by such a lack of balance, which most seafarers experience as stressful. Many technological and social duties on board a ship have, at an increasing rate, become more complicated. But, at the same time, a lot of simple manual but time consuming duties, like maintenance, are still unchanged. This has also made the duties far more diverse than earlier (e.g., special requirements for new skills and new types of job content). Our hypothesis is that poorly fulfilled general psychological job requirements are closely linked with a fundamental lack of balance between tasks and methods used to complete them. This leads to a non-satisfying working and living situation, which is expressed in different stress symptoms, such as frequent psychosomatic illness, frequent injuries to people and materials,

high turnover in the crew, low operational effectiveness, and conflict between persons and groups. [Presents] programme for improving the quality of working life at sea.

Johns, M. W. Stress and coronary heart disease. In A. T. Welford (Ed.) Man under stress. Proceeding of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Johnsen, T. B. Data Analysis. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Johnson, J. & Sarason, I. G. Recent developments in research on life stress. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

Given the physical and psychological demands involved in coping with high levels of life change, it is not surprising that many clinicians have suggested that the experiencing of major life changes can have a deleterious effect on the functioning of the individual. While speculation concerning the effects of life change has been prominent in the medical and psychiatric literature for many years it is only recently that researchers have begun systematic investigations into the relationships between life stress, health, and psychological adjustment. In this chapter we present an overview of some of the early findings of life stress research, discuss the nature of conceptual and methodological difficulties associated with studies in this area, and describe a series of studies designed to deal with certain of these issues.

Johnston, W. A., Howell, W. C. & Zajkowski, M. M. Regulation of attention to complex displays. Journal of Experimental Pschology, 1967, 73 (3), 481-482.

Eight practiced Os monitored an 8 x 8 matrix for 200 min. and detected additions and deletions of alphanumeric stimuli. Half the stimuli contained the same number (similar stimuli), and half contained different numbers (different stimuli). Detection latencies were shortest for additons of similar stimuli and longest for deletions of dissimilar stimuli. Vigilance effects were confined to dissimilar stimuli: a decrement and end spurt for deletions, a compensentory increment and terminal decline for additions. The notion that signals reinforce direction of attention was supported.

Kak, A. V. Stress: an analysis of physiological assessment devices. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

This paper will evaluate various physiological-dependent measures that have been proposed as indicators of stress. In contrast, the description of particular devices or methodologies for measuring these physiological parameters will only be of secondary importance.

Kalimo, R., Leppanen, A., Verkasalo, M., Peltomaa, A. & Seppala, P. Mental strain in machine-paced and self-paced tasks. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

The aim of the study was to clarify the effect of machine pacing on mental strain. The subjects were 330 female workers doing repetitive tasks in the printing industry. The subjects represented three forms of workpacing: unmechanized self-pacing, a medium level of machine pacing with one machine, and a high level of machine pacing on a machine line. A questionnaire, a daily self-rating of one's own state, and cortisol measurments from urine samples revealed only a few differences between the groups. There was a slight indication of higher mental strain among the members of the highly machine-paced group when they were compared to the subjects of the study. The similarity of the responses of all the groups may be due to a selection to and from the occupations under study, adaption, and a relative flexibility of the machine lines studied [emphasis is the author's].

Kamon, E. Aspects of physiological factors in paced physical work. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

The capacity to perform physical work depends on age, gender, and fibre types of the muscles. Therefore, muscular performance is reviewed with respect to maximal performance capacity for dynamic work and for static work on the basis of the expected maximal uptake and maximal voluntary contraction. Limitation in performance of dynamic and static work due to the muscles' fibre composition is also shown. Not considering fibre types, predictors for working and resting periods, applicable to machine pacing, are given for dynamic and for static work. The schedules of work and rest are aimed at non-fatiguing working conditions and they are based on estimates of the demand of the task and the expected maximal capacity adjusted for age and for gender.

Karasek, R. A. Job decision latitude, job design, and coronary heart disease. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Job-design strategies in industrial society have emphasized restriction in skill requirements and decision authority for major groups of workers, to enhance productivity. This principle is questioned as to its productive efficiency. Furthermore, low skill requirements and decison authority are shown to be related to psychological strain, at the individual and occupational level, and to the prevalence of cardiovascular illness in the USA, and to both prevalence and incidence of cardiovasuclar illness in Sweden.

Kasl, S. V. Epidemiological contributions to the study of work stress. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

[Discusses] the nature of the empirical evidence and the degree to which it permits inferences about the effects of some aspects of the work environment on worker health and well-being. . . . [Uses] indicators of cardiovascular health, diverse indicators of mental health, and indices of job satisfaction. . . . We must be constantly on the lookout for an interplay between the physical setting of work and the physical task demands, and the psychological appraisal and reaction to these.

Kasl, S. V. The impact of retirement. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Kets de Vries, M. F. R. Stress and the entrepreneur. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Kinney, J. S. & McKay, C. L. The visual evoked cortical potential as a measure of stress in naval environments: III. The respnse to pattern and color. US Naval Submarine Medical Research Laboratory Report, 1974 (Mar). No.778, 19p.

Previous research has shown that it is possible to isolate a response to pattern from the VECP. Optimum conditions for yielding a pattern response were investigated and then the pattern response was applied to a test of color vision. The technique can be used as an objective measure of color vision.

Korchin, S. J. & Ruff, G. E. Personality characteristics of the Mercury astronauts. In G. H. Grosser, H. Wechsler & M. Greenblatt (Eds.) The threat of impending disaster. Cambridge, MA: M.I.T. Press, 1964.

Kramer, J. J. (Ed.) The role of behavioral science in physical security. Proceedings of the first annual symposium, April 29-30, 1976, (NBS SP-480-24). Washington, D.C.: Human Factors Section, Center for Consumer Product Technology, National Bureau of Standards, November 1977.

[Contains the proceedings of a Symposium/Workshop on the application of behavioral science to the problem of physical security. The formal papers are divided into three topical sections: (1) Threat Analysis - Behavioral Factors and Consequences, (2) Human Reliability - Response Forces vs. Adversay, and (3) Methods of Measuring Behavioral Impact - Quantitative vs. Qualitative. Questions and challenges were explored in open discussion sessions following many of the presentations. The volume concludes with a brief summary of the panel-type workshop on the subject of threat analysis held on the second day.]

Kramer, J. J. (Ed.) The role of behavioral science in physical security. Proceedings of the 2nd annual symposium, March 23-24, 1977, (NBS SP-480-32). Washington, D.C.: Center for Consumer Product Technology, National Bureau of Standards, Jun 78.

[The second symposium provided a forum for presenting and discussing continuing current behavioral science contributions to physical security. Nine papers were given; questions and challenges were explored in an open discussion session at the end of the first day; and the symposium concluded with a panel session devoted to a synthesis of the material presented and a discussion of future research directions.]

Kramer, J. J. (Ed.) The role of behavioral science in physical security. Proceedings of the third annual symposium, May 2-4, 1978 (NBS SP-480-38). Washington, D.C.: Center for Consumer Product Technology, National Bureau of Standards, December 1979.

[The symposium provided a forum for the exchange of information between specialists in physical security and behavioral science through the presentation of eight papers and four structural workshops: Human Sensory Capabilities/Limitations; Human Engineering of the Workplace; Human Motivation, Attitudes, Error/Reliability; Personnel Selection, Placement, Training. The symposium concluded with a summary and synthesis of the results of the workshops and a panel discussion on new research thrusts.]

Laabs, G. J. & Stager, P. Monitoring the information-processing demands of attention switching. Canadian Journal of Psychology, 1976, 30 (2), 47-54.

Demands on information processing capacity were examined in three experiments by combining auditory digit-tasks involving attention switching with the secondary task of pursuit tracking. Secondary task scores in two experiments were lower for tracking segments involving signalled switches between digit-taks and between input channels, respectively. These results

could not be accounted for by a trade-off between digit-task and tracking performance. When the attended channel was defined by voice quality in a third experiment, tracking performance was not affected by switches between input channels. A comparison of the present results and those of related studies indicates that switching attention per se between input channels does not constitute the primary demand for central processing capacity in dichotic tasks. The increased demnd demand appears to be related instead to the concomitant changes required in the input processing and to the processing of signals to switch the focus of attention.

Lapinsky, Jr., G. W. & Goodman, C. Psychological deterrents to nuclear theft: An updated literature review and bibliography (NBSIR 80-2038). Washington, D.C.: Law Enforcement Standards Laboratory, U.S. Dept. of Commerce, National Bureau of Standards, May 1980.

Although the literature indicates that psychological processes can be directly influenced by a variety of means, there is very little empirical data that is directly related to the question of psychological deterrence, and especially the deterrence of a highly motivated adversary. A variety of techniques are presented, some of which may be feasible, others which may not. Only through further, specific applied research and field experimentation can the effectiveness of these hypothesized deterrents be tested. Implementation without further research could, in some cases, have disastrous effects e.g., a poorly thought-out public relations campaign could serously injure the credibility of an agency, cause a loss of public confidence, and actually invite an attack rather than deter it. Data bases reviewed include: The National Criminal Justice Reference Service (NCJRS); Psychinfosearch; National Technical Information Service (NTIS); Defense Documentation Center (DDC); Sociological Abstracts; Ergonomics Abstracts and Social Science Citation Index.

Lapinsky, G. M., Ramey-Smith, A. & Margulis, S. T. (Eds.) The role of behavioral science in physical security. Proceedings of the fourth annual symposium, July 25-26, 1979 (NBSIR 81-2207 (R)). Washington, D.C.: Center for Consumer Product Technology and Center for Building Technology, National Bureau of Standards, February 1981.

The symposium provided a forum for presenting and discussing current behavioral science contributions to physical security. Generally, attendance was limited to key personnel in the services, other Government Agencies, and private firms currently on contract with the Defense Nuclear Agency. Papers were presented on the first day, followed by a discussion session the second day.

Lazarus, R. S. A laboratory approach to the dynamics of psychological stress. In G. H. Grosser, H. Wechsler & M. Greenblatt (Eds.) The threat of impending disaster. Cambridge, MA: M.I.T. Press, 1964.

Lazarus, R. S., Deese, J. & Osler, S. F. The effects of psychological stress upon performance. Psychological Bulletin, 1952, 49 (4), 293-317.

Introduction. An understanding of the effect of psychological stress upon skilled performance is of great theoretical and practical importance. People are often faced with the necessity of performing skilled work under conditions which are highly stressful. The problems of stress involve questions of emotions, motivation, and learning. Many theoretical issues in these fields are of basic importance in an analysis of the effects of stress upon performance. Most of the experimental work upon stress has been undertaken for theoretical rather than practical reasons. The problem of the effects of stress cuts across many fields. [The authors present a psychoanalytic concept of stress followed by a description of various experimental techniques used to induce stress. The kinds of performance which have been studied under stress are briefly reviewed, and finally, some of the theoretical implications of the work on stress and skilled performance are discussed] . . . . Because people differ in motivations and in the ways they deal with them, it is never really possible to define a general stress stiuation. The situation will be more or less stressful for the individual members of the group, and it is likely that these differences in the meaning of the situation will appear in terms of performance.

Lester, J. T. An annotated bibliography of DoD-funded reports concerning psychological stress: 1950-1978. Boston, MA: Office of Naval Research, *Eastern/Central Regional Office, September 1979.*

Presents reports pertaining to the subject of psychological stress (studies in which the emphasis was on physiology were excluded). 356 entries are arranged chronologically. There is a brief discussion of the extent and focus of DoD interest in the subject of stress, and an index to reports based on a content classification. Current on-going Work Units are annotated in a separate section.

Levine, S. Cortisol changes following repeated experiences with parachute training. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

[Plasma cortisol levels measurements were high on the first jump day but decreased significantly on the second and third jump days. Levine concluded that coping mechanisms appeared to develop very rapidly] after just one exposure [and supported previous studies where the coping mechanism in humans can affect the adrenocortical response to stress in the pituitary-adrenal system.]

Levine, S., Weinberg, J. & Ursin, H. Definition of the coping process and statement of the problem. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

This book is a report covering an extensive investigation of behavioral and physiological parameters following repeated exposure to a distinctly threatening situation. The purpose of the study was to examine whether mastery of fear took place, what behavioral and personality variables affectd its ultimate accomplishment, and whether detectable biological changes occurred as a consequence of this mastery. The remainder of this volume is a comprehensive report of a study utilizing the model of parachute training as a prototype for the study of coping. There are a number of very important factors that make this study unique. First, the study was conducted within the conceptual framework of an experimental model of coping. Thus, the situation was chosen to have as many of the features of the experimental model as was possible within a naturalistic framework for humans. Second, all of the individuals who were tested were naive; thus, we could follow the course of changes in both performance and physiological measurements. Third, in the late 1960s and early 1970s, there was an enormous development in the techniques available for the appropriate measurement of multiple hormones in the blood. This study utilized many of these techniques to measure several hormones at the same instant so as to be able to establish relationships between physiological measures. Finally, psychological testing was done prior to the initiation of training, and performance measures were taken during training. Thus, we hoped it would be possible to correlate the physiological measures with each other, to correlate the psychological measures with each other, and to find relationships between the physiological and psychological measures. We believe that the results of these studies make significant contributions to the understanding of the coping process.

Lewis, G. W. Job performance and brain asymmetry: Relevance for physical security personnel. Presented at the Fifth Annual Meeting on the Role of Behavioral Science in Physical Security, held 11-12 June 1980, at the National Bureau of Standards, Gaithersburg, Maryland.

Conventional paper-and-pencil personnel testing is able to predict academic performance fairly well, but not on-job performance. This may be due to heavy reliance on left hemisphere brain processing (verbal, analytical). On-job performance may place heavy demands on right hemisphere brain processing (spatial, simultaneous). Three research projects are described, which relate on-job performance to brain asymmetry as measured by visual event related brain potential (VERP) procedures. The three projects relate VERP measures to aviator performance in F-4 fighter aircraft, antisubmarine warfare trainee performance on a sonar simulator, and enlistee promotins over three years. One of our most consistent findings relates the VERP asymmetry standard deviation (SD) measure to performance for the personnel tested in these three projects. The asymmetry SDs are least for high performers and greatest for low performers in both front and back brain areas. Relevance in applying brain wave measures to physical security personnel

areas is discussed. Future directions of behavioral research using noncontact (magnetic) recordings from the brain are suggested for physical security personnel assessment. Plans for investigating possible holography applications are also noted.

Lewis, G. W. Biotechnology predictors of physical security personnel performance. Presented at the Sixth Annual Meeting on the Role of Behavior Science in Physical Security, held 3-4 June 1981, Washington, D. C.

The military services depend heavily on paper-and-pencil testing to evaluate personnel. Such testing is able to predict school and training performance fairly well, but not on-job performance. On-job performance places heavy demands on right hemisphere processing (spatial, integrative, simultaneous) in addition to left hemisphere processing (verbal, analytical) which paper-and-pencil testing primarily measures. This Center has been investigating the feasibility of directly assessing brain functions using event related brain potential (ERP) recordings to improve the prediction of on-job performance. Promising results have been found in relating ERP data to the performance of pilots, radar intercept officers antisubmarine warfare trainees and basic recruit trainees. Under Defense Nuclear Agency funding, this Center recently undertook (FY81) a research project to determine the feasibility of using biotechnology measures (e.g., ERP) to improve the prediction of physical security personnel performance reliability. Predicting the tolerance to stress/duress is of particular interest. Project plans and progress are reviewed in this presentation.

Lewis, G. W. Personnel applications of event related brain potentials. In B. Rimland (Ed.), Independent research and independent exploratory development at the Navy Personnel Research and Development Center. (NPRDC Spec. Rep. 82-27). San Diego: Navy Personnel Research and Development Center, June 1982 (AD-A117 630).

Lewis, G. W. Event related brain electrical and magnetic activity: Toward predicting on-job performance. International Journal of Neuroscience, 1983.

Lewis, G. W., Federico, P-A., Froning, J. N. & Calder, M. Event related brain potentials and cognitive processing: Implications for Navy training (NPRDC TR 82-8). San Diego: Navy Personnel Research and Development Center, October 1981 (AD-A109 019).

This report describes the evaluation of a relatively new technology, the analysis of event related brain potentials (ERPs), as a possible means of improving Navy training. The subjects were 50 Navy recruits undergoing basic military training. Eight channels of visual, auditory, and bimodal ERP data were recorded for each subject from scalp contact electrodes. Microvolt standard deviation amplitude measures were computed. During the same test

session, but not concurrently, a battery of cognitive style, aptitude, and ability paper-and-pencil tests were given to the subjects.

The subjects were clustered into two groups, or types, based on the paper-and-pencil tests. Type 1 subjects represented a "spatial processing" group, while Type 2 represented a "verbal processing" group. (Recent research indicates that the left hemisphere processes primarily verbal, analytic and sequential information, while the right hemisphere processes spatial, integrative or simultaneous information.) ERP variables were input to discriminant analysis to differentiate the two groups. No visual or bimodal ERP variates discriminated or validated the classification matrices. Auditory ERP variates differentiated ($p < .01$) and validated ($p < .005$) the two groups. Greater amplitude asymmetry areas were found with visual stimuli for the "spatial" group and with auditory stimuli for the "verbal" group. Greater sensory interaction was found in the right hemisphere for the "spatial" group and in the left hemisphere for the "verbal" group.

Lewis, G. W. & Froning, J. N. Sensory interaction, brain activity, and reading ability in young adults. International Journal of Neuroscience, 1981, 15, 129-140.

Forty-one Navy recuits were divided into two groups (HIGH versus LOW) based on reading ability. Eight channels of visual (VERP) auditory (AERP), and bimodal (BERP) event related brain potential data were analyzed in order to assess the relationship between sensory interaction and reading ability. The HIGH group showed greater VERP amplitude than did the LOW group, while the LOW group showed greater AERP and BERP amplitude than did the HIGH group. Discriminant analysis provided separation of the two groups when VERP and AERP variables were used but not BERP variables. Sensory modality interaction was assessed through the derived expression [BERP-(VERP + AERP)]. Group grand average waveforms were obtained and evaluated by the derived expression. Greatest group differences were found late in the waveform (between 300 and 400 msec) suggesting that sensory interaction also affects higher-order cognitive functioning. Distractability may partially account for the ERP differences found for the two reading groups.

Lewis, G. W. & Rimland, B. Hemispheric asymmetry as related to pilot and radar intercept officer performance (NPRDC TR 79-13). San Diego: Navy Personnel Research and Development Center, March 1979 (AD-A068 087).

This report describes the application of a relatively new technology, the visual evoked potential (VEP) method of brain wave analysis, as a possible means of improving the prediction of performance in an area that has proven intractable to more conventional training procedures--the military aviator. The subjects were 28 pilots and 30 radar intercept officers (RIOs) assigned to a Navy Readiness Training Squadron. VEP data were obtained from eight scalp electrode sites for each aviator. Ratings by the operations officer served as the criterion of performance. It was hypothesized that: (1) VEP amplitude differences would be found between the pilot and RIO groups, and

(2) within the pilot and RIO groups, individual performance ratings would be related to VEP hemispheric asymmetry (amplitude differences between the right and left hemispheres).

Lewis, G. W. & Rimland, B. Psychobiological measures as predictors of sonar operator performance (NPRDC TR 80-26). San Diego: Navy Personnel Research and Development Center, May 1980 (AD-A085 030).

This report describes the application of a relatively new technology, the visual event related to brain potential (VERP) method of brain wave analysis, as a possible means of improving the prediction of performance of sonar operators. The subject, 26 trainees at the Fleet Antisubmarine Warfare (ASW) School, were assigned to a HIGH or LOW group based on their performance of a sonar simulator task. Eight channels of VERP data were recorded for each subject from scalp contact electrodes, and microvolt root means square amplitude measures were computed for the wave forms at each of the eight electrode sites. To assess relationships between the brain's right hemisphere (RH) and left hemisphere (LH), asymmetry measures were computed by subtracting the LH amplitude value from the RH value for each of the homologous sites. Results of discriminate analysis performed to discriminate the HIGH and LOW groups showed smaller VERP amplitudes for the HIGH group than for the LOW group. Also, hemispheric asymmetry was greater for the LOW than the HIGH group, especially in the occipital (visual processing) area of the head. Aptitude tests used by the Navy in selecting recruits for sonar training showed no differences between the two performance groups.

Lewis, G. W., Rimland, B. & Callaway, E. Visual event related potentials: Toward predicting performance. In E. Callaway, P. Tueting & S. H. Koslow (Eds.) Event related brain potentials in man. New York: Academic Press, 1978.

Three studies with male Navy trainees used factor, discriminant and cluster analyses to predict various criteria: I. Aptitude group membership (N=206), with variability, amplitude (F4, P3, C4) and latency variables; II. Pass vs. Fail status in remedial reading (N=73), with amplitude (F4, P3) variates; III. High vs. Low sonar simulator performance (N=26) with amplitude (01, C4) variates.

Ley, R. G. & Bryden, M. P. Hemispheric differences in processing emotions and faces. Brain and Language, 1979, 7, 127-138.

Visual field differences for the recognition of emotional experession were investigated using a tachistoscopic procedure. Cartoon line drawings of five adult male characters, each with five emotional expressions ranging from exgremely positive to extremely negative, were used as stimuli. Single stimuli were presented unilaterally for 85 msec. Subject (N=20) were asked to compare this target fact to a subsequent centrally presented face and to decide

whether the emotional expression of the two faces, or the character represented by the two faces, were the same or different. Significant left visual field (LVF) superiorities for both character and emotional expression recognition were found. Subsequent analyses demonstrated the independence of these effects. The LVF superiority for emotional judgments was related to the degree of affective expression, but that for character recognition was not. The results of this experiment are consistent with experimental and clinical literature which has indicated a right hemisphere superiority for face recognition and for processing emotion stimuli. The asymmetry for emotion recognition is interpreted as being an expression of the right hemisphere's synthetic and integrative characteristics, its holistic nature, and its use of imagic associations.

Lindstrom, K. & Mantysalo, S. Attentive behaviour after exposure to continuous industrial noise. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis Ltd, 1981.

Attentive behaviour in a choice reaction-time task was studied in 11 workers exposed to continuous industrial noise and nine workers not exposed to such noise. The measurements were taken in three experimental sessions (before, in the middle, and after the workshift) in order to evaluate the possible aftereffects of noise and other workloads. Acute and chronic symptoms of strain were also investigated. The group exposed to noise revealed a greater variability in reaction time than the controls. The slow reaction times of the exposed group were related to the acute strain ratings, while those of the control group were more dependent on chronic fatigue symptoms. The work of the exposed group also included more time pressure.

Mackie, R. Some human factors that influence reliability of signal detection and identification in surveillance systems (NBS Special Publication 480-24). In The role of behavior science in physical security. Washington, D. C.: National Bureau of Standards, Proceedings of the First Annual Symposium, April 29-30, 1976.

The purpose of this paper is to describe some human capabilities and limitations that significantly influence the overall performance of surveillance systems. First, factors that influence the ability of human operators to maintain high levels of attention for critical signals or events that may occur very infrequently or unexpectedly will be discussed. This is the area of human behavior generally known as vigilance. Second, consideration will be given to some of the factors associated with signal interpretation where the recognition of characteristics that differentiate a signal of interest from system noise or other background signals is of paramount importance. This is the very complex area of pattern recognition. Both signal detection and signal interpretation are elements of most surveillance systems and each poses very significant problems in designing the most effective possible surveillance system.

Mackie, R. R. (Ed.). Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Macpherson, R. K. Thermal stress and thermal comfort. In A. T. Welford (Ed.) Man under stress. Proceeding of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Mandler, G. Thought processes, consciousness and stress. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

There is one important change in what cognitive psychology is about. Traditionally, and certainly earlier this century, there was a significant tie between cognitive and phenomenological concerns. Cognitive psychologists frequently used as primitive terms of their language those terms of the common language that referred to cognitive processes -- and frequently these terms were coextensive with phenomenological usage. Thus intuitively 'obvious' judgmental terms such as 'good' and 'bad', comparative terms such as 'better' and 'similar', and references to processes such as 'concious' and 'self' formed the basic vocabulary of cognitive theories. The new cognitive psychology, the human information processing approach, instead searches for the processes and mechanisms that generate these terms and usages, and that in fact generate language as such. Such an approach to problems of thought and stress will form one of the themes of the following pages . . . . If the experimental literature on stess and memory fails to respond to the need to examine underlying cognitive processes, unfortunately experimental work on stress and problem solving fails even more. It has been known, both by laymen and psychologists, that under stress the thought processes involved in problem solving demonstrate the kind of narrowing and stereotyping that we would expect on the basis of the present analysis . . . . Thought processes become narrowed in the sense that only the available alltternatives are considered and no conscious capacity is available to consider new alternatives . . . . What is needed are some fine-grained experimental analyses of these processes during problem solving. How, and when, does the introduction of stress (however produced or defined) restrict the available alternatives in the conscious state? Which processes are suppressed or removed from consciousness and in what order? Does the very inability to solve a problem due to stress potentiate further stress reactions because of the interruptive process of the failure to solve a problem? . . . . The research potential under the aegis of the new mentalism is indeed great, but our preoccupation with the normal unstressed mind has, in recent years, restricted experimental work on these problems.

McCormick, E. J. Comments from the sidelines. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Many manifestations or indicators of work-related stress have been reported, including physiological and physical indicators, psychological and attitudinal indicators, effects on job performance, and accidents and injuries. Further, there is evidence that work-related stress is very pervasive, extending over the entire spectrum of the relationship of people to work, starting with the interpersonal relationships of workers with their supervisors or with other workers, with certain characteristics of organizations, and with environmental variables. The objectives of stress-related research probably should be focused on its reduction to acceptable levels rather than towards its elimination.

McEwen, J. C. Working conditions with different types of disability. In A. T. Welford (Ed.) Man under stress. Proceeding of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

McGrath, J. E. A conceptual formulation for research on stress. In J. E. McGrath (Ed.) Social and psychological factors in stress. New York: Holt, Rinehart & Winston, 1970 (a).

McGrath, J. E. Settings, measures, and themes: An integrative review of some research on social-psychological factors in stress. In J. E. McGrath (Ed.) Social and psychological factors in stress. New York: Holt, Rinehart & Winston, 1970 (b).

McGrath, J. E. Stress and behavior in organizations. In M. D. Dunnette (Ed.), Handbook of industrial and organizational psychology. Chicago: Rand McNally, 1976.

We are here concerned with stress and behavior in organizations. It must be admitted at the outset that "stress" is not a very precise concept. Nor is "behavior in organizations," for that matter. So our first task will be to lay out a framework in which we try to tell the reader how we will use these imprecise terms of "stress," "behavior," and "organizations." The first section deals with stress. In it we discuss some of the key substantive and methodological issues in the stress area, and lay out a general paradigm for conceptualizing stress. The latter part of that section describes, in some detail, a recent study in which we tried to test a stress theory, derived from the key substantive propositions in the stress area, within a realisitic setting. That study led us to question some of the central premises of "stress theory," and to the formulation of a new model of stress, arousal, and performance. The new model has some dramatic implications for theory and practice. The second section deals with behavior in organizations. It

starts with a general framework from which we can derive six potential "sources" of stress. Then, each of these six sources is examined, in turn, in relation to our stress model. The chapter ends with a brief commentary on problems and potentialities for future research on stress and behavior in organizations.

McMichael, A. J. Personality, behavioral, and situational modifiers of work stressors. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

The fundamental premise underlying the following discussion is that different individuals will react differently to the same work environmental conditions--some finding them comfortable and rewarding, others experiencing them as quite stressful . . . . The growing awareness, and documentation, of how an individual worker's response to environmental stressors is conditioned by personal and life situational variables accords with a similar growing awareness in other areas of biomedical research. And, ultimately, all such awareness is, implicitly, a recognition of how the process of natural selection necessarily operates. Despite differences in terminology . . . the phenomena are essentially identical [emphasis is the author's] . . . . In striving to illuminate the psychosocial phenomena involved in the experiencing of, and responding to, occupational stress, different investigators have proposed models of varying elaboration and complexity. Given that models are not themselves reality, but are merely stylized, and necessarily simplified, representations of an inferred reality, the risks of overly elaborate models should be borne in mind. A good model must, among other things, communicate and inform--by capturing the essential ideas, without distracting by the inclusion of unwarranted detail.

Meister, D. The problem of stress definition. In G. Salvendy and M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Stress research presents serious difficulties: lack of definition of the phenomenon being studied; inability to determine whether one is dealing with an independent, dependent or intervening variable or all three simultaneously; inability to differentiate stress from other related phenomena such as fatigue. Some hypotheses about stress dimensions and their research implications are presented.

Miles, R. H. Boundary roles. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Miller, J. C. & Mackie, R. R. Vigilance research and nuclear security: Critical review and potential applications to security guard performance. HFR Technical Report 2722, 1980.

Moore, R. T., Carpenter, R. J., Holt, A. W., Koenig, A. L. & Warnar, R. B. J. Phase II final report: Computerized site security monitor and response system (NBSIR 79-1725). Washington, D.C.: Computer Systems Engineering Div., Inst. for Computer Sciences and Technology, National Bureau of Standards, U. S. Dept. of Commerce, March 1979.

The Computerized Site Security Monitor and Response System (CSSMRS) was conceived as an integrated, state-of-the-art, computer based system to enhance and improve the overall physical security of storage sites for nuclear weapons and materials. This would result from the interconnection of all site security systems including intrusion detection equipment, duress alarms, guard radio and telephone systems, guard activity sensors, access control equipments, meteorological and environmental sensors and deterrent systems to a distributed processing network of computers. These would be expected to provide timely, accurate and unambiguous information about the site security statusor the progress of an attack of intrusion attempt. To the extent that is feasible, appropriate response initiatives would be preprogrammed into the system. Changes in site security status and the resulting response actions would be automatically reported up-channel to higher command levels and backup and reserve forces would be automatically called out in the event of certain identifiable threat situations, particularly those in which continued survival of local guard forces might be doubtful.

Work on the CSSMRS project is being conducted in three phases. In Phase I, research was conducted to determine the applicability and feasibility of certain concepts, to develop the broad outlines of the system desgn, and to identify specific areas where further research and development effort would be required. The characteristics of the evolving Forced Entry Deterrent Systems (FEDS) were considered and recommendations were made in support of the development of taggants and trace material detection systems to facilitate the detection and apprehension of an adversary who might have been exposed to a FEDS. In Phase II, the various technical alternatives were evaluated, and the physical and functional attributes of the various subsystems and components were identifed. In Phase III, one or more prototype CSSMRS systems will be procured and installed at appropriate sites for field test and evaluation.

Morgan, Jr., B. B. Stress-related effects in the assessment of synthetic-work performance. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

The synthetic-work methodology has been employed for over 20 years to assess the effect of stresses such as work-rest schedules, sleep loss, continuous work and illness on complex operator performance. Conclusions

drawn from this programme of research are summarized here in order to provide guidelines for future stress research. This summary indicates that future research should concentrate on the assesment of work-performance rather than test-performance responses to occupational stresses. It also suggests that additional research is needed to investigate the patterns of stress-related responses produced by different types of stresses of different severity, individual differences, and interacting variables such as performance strategies, the circadian rhythm, and extramural demands. The need for studies of the recovery from stress effects is also discussed.

Musicant, R. A. Evoked potentials and attention. Biological Psychology Bulletin, 1975, 4 (1), 1-9.

[Reviews the literature on] the effects of selective attention on averaged evoked potentials in humans. Emphasis is placed on the control procedures necessary to demonstrate an effect of attention per se, as opposed to possible general effects of shifts in arousal. There is sufficient evidence to favor the hypothesis that there is a direct effect of attention on evoked potentials. There may be consistant individual differences in the effect of attention on an early component of the EP, while a late component shows little intersubject variability. The proposal is discussed in terms of 2 separate attentional processes that may be reflected by the early and late components.

Naitoh, P. & Lewis, G. W. Statistical analysis of extracted features. In N. Yamaguchi & K. Fujisawa (Eds.), Recent advances in EEG and EMG data processing. The proceedings of the International Conference on EEG and EMG data processing. New York: Elsevier, 1981.

A crucial problem faced by EEG investigators lies in better understanding of improved, but increasingly complex EEG and event-related potential (ERP). When and how can investigators be sure that spectra/ERPs have changed significantly, due to an experimental treatment or an altered state of their subjects? More importantly, how can they express interrelations among spectra/ERPs or be sure that their findings will be reliably repeated in the future? These questions may be raised also in the manner of handling other features extracted form the EEGs than just spectra and ERPs. The purpose of this paper is to address these questions by describing specific statistical methods for handling features from the EEGs. This paper also intends to suggest statisical resources already available in the literature.

Norman, D. A. & Bobrow, D. G. On data-limited and resource-limited processes. Cognitive Psychology, 1975, 7, 44-64.

This paper analyzes the effect on performance when several active processes compete for limited processing resources. The principles discussed show that conclusions about the interactions among psychological processes must be made with caution, and some existing assumptions may be unwarranted. When two (or more) processes use the same resources at the same

time, they may both interfere with one another, neither may interfere with the other, or one may interfere with a second without any interference from the second process to the first. The important principles are that a process can be limited in its performance either by limits in the amount of available processing resources (such as memory or processing effort) or by limits in the quality of the data available to it. Competition among processes can affect a resource-limited process, but not a data-limited one. If a process continually makes preliminary results available even before it has completed all its operations, then it is possible to compute performance-resource operating characteristics that show how processes interact. A number of experiments from the psychological literature are examined according to these processing principles, resulting in some new interpretations of interactions among competing psychological processes.

Norman, D. A. & Rumelhart, D. E. Explorations in cognition. San Francisco: Freeman, 1975.

This book is a study of mental processes. Our goal is the experimental and theoretical understanding of human cognitive processes . . . . The book has seven parts. Part I is an introduction to the problems that we have studied and to the philosophy with which we have pursued our investigations . . . . Part II presents the basic theoretical approach. Here, we first develop the ideas that underlie the notion of the active structural network as a representational format for knowledge . . . . Starting with Part III the book becomes less general. We discuss the processes involved in the analysis of language, explain and justify the system we have adopted, and show how it can aid the study of reading. In Part IV, we show how the ideas about language processing and memory representation can be implemented in a computer, both as a demonstration of the completeness and adequacy of the ideas and as a vehicle for future testing and development . . . . Parts V, VI, and V present individual research studies of particular aspects of the representational system that were discussed in the earlier chapters. These final chapters extend the theoretical work to other domains of inquiry -- experimental studies of language and memory, the development of language in children, visual perception, problem solving, and question answering.

Norum, K. & Ursin H. Fatty acid mobilization. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

[Plasma fatty acid levels increased from the basal level the first day. Thereafter, the measures significantly decreased as experience increased during training, and finally decreased to a level that was in the same region as the 'basal' value. The increase in fatty acids could not be attributed to any physical exercise.]

Ogden, G. D., Levine, J. M. & Eisner, E. J. Measurement of workload by secondary tasks. Human Factors, 1979, 21 (5), 529-548.

The post-1965 literature on the use of secondary tasks in the assessment of operator workload was surveyed. Twelve classes of tasks were identified; the most frequently used were choice reaction time, memory, monitoring, and tracking. The literature review did not suggest a single best task or class of tasks for the measurement of workload. Limitations in using secondary tasks are discussed, and directions for future research are presented. [Presents 144 secondary tasks related to their primary tasks and their results]: Table 1 -- Classification of Tasks Used in Studies Measuring Workload by Secondary Task Techniques. The results are typically presented in terms of the effect of either the secondary task or the primary task upon performance of the other except where noted otherwise.

O'Hanlon, J. F. Stress in short-cycle repetitive work: general theory and an empirical test. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Epidemiological research has suggested that repetitive work can be stressful, but owing to deficient methodology, and the multicausal/variable-effect nature of that stress, the results were inconclusive. Recent use of catecholamine excretion rates as a non-specific index of occupational stress has provided a clearer indication of the relatively high level of stress present in workers employed in the most repetitive tasks. A theory was advanced to explain the occurrence of this stress as the result of (1) habituation, (2) diminished arousal leading to transient performance failures, (3) re-occurring compensatory effort, (4) anticipation of failure with associated feelings of anxiety and hostility [emphasis is the author's. These effects, and their concomitant factors may also translate/apply to the long-term vigilance routines of security guards personnel.] One prediction was made from this theory; i.e., in short-cycle, machine-paced work, stress effects would increase with the difficulty of the task's perceptual requirement. This was confirmed in a laboratory simulation of a repetitive packaging task.

O'Hanlon, J. F. & Beatty, J. Concurrence of electroencephalographic and performance changes during a simulated radar watch and some implications for the arousal theory of vigilance. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

A simulated sea-surveillance radar monitoring task was employed to study the relationships between target detection performance and various physiological indices of arousal. Twenty subjects performed the task under different conditions designed to elicit differences in performace and arousal. Detection performance efficiency deteriorated as a function of time during a prolonged radar watch and improved during short alerted tests. electrocortical changes involving the percentages of theta, alpha, and beta waves in the

spontaneous EEG were consistent in showing a relationship between arousal and vigilance. Mean changes in heart rate occurred in parallel with performance and electrocortical changes under certain conditions, but the former were not correlated with the latter on an individual basis. The work is viewed as supporting an extension of the arousal hypothesis of vigilance into more practical occupational settings.

Organ, D. W. (Ed.) The applied psychology of work behavior: A book of readings. Dallas, TX: Business Publications, Inc., 1978.

Oshima, M. The mechanism of mental fatigue. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Extensive experimentation by the author suggests that critical flickering frequency is an effective methodology for measuring mental fatigue. A number of experimental studies are presented to illustrate this relationship.

Parasuraman, R. & Davies, D. R. A taxonomic analysis of vigilance performance. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Task classification is introduced as a method for the evaluation of vigilance behavior in different task situations. On the basis of an analysis of different vigilance tasks, several task "dimensions" of relevance to a taxonomy of vigilance tasks are identified. The perceptual speed and flexibility of closure ability categories, which may also be identified with signal discrimination type, are considered to comprise one of the major dimensions in the taxonomy. In the first study, two experiments are reported whose results indicate that these ability categories exert a significant influence on the determination of the consistency of performance between different vigilance tasks, and that individual differences in vigilance performance are not so much task specific as task-type specific. In the second study, it is demonstrated that a classification of the vigilance literature leads to an improved specification of the types of tasks in which reliable decrements in efficiency occur, in terms of a few dimensions of the vigilance task taxonomy. It is concluded that task classification enables the specification of task situations to which particular classes of performance are restricted, and the systematization of the research literature so that improved generalizations can be made in extrapolating data from one laboratory task to another and from laboratory to operational tasks.

Payne, R. Epistemology and the study of stress at work. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

Payne, R. L. Stress and cognition in organizations. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

Social existence is organized existence: even the family can be viewed as an organization. Most of us then spend most of our time in one form of organization or another. This chapter offers some ideas about how we can describe organizations and discusses the relationships beytween organizational forms and human cognitive processes. Whilst it is fashionable to advertise the amount of stress that occurs in modern organizations, it is also true that one function of organizations is to absorb stress, so that individuals can obtain things together that would be denied them singly . . . . The organization of the chapter will follow the structure of its title. I shall classify psychological states into two broad classes; those which are stressful (pressure and depreivation) and those which are positively desirable (well-being). I shall then describe a model of human cognitive functioning which posits three interrelated processes . . . . Four organizational form are then delineated . . . . Finally, the three major setting are brought together by considering the positive and negative consequences (stress) [of the functions of the model].

Payne, R. Organizational stress and social support. In C. L. Cooper & R. Payne (Eds.) Current concerns in occupational stress. New York: John Wiley, 1980.

Pearson, R. G. Subjective reports of stress and strain as concomitants of work. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Psychometric scales which have been used to assess work-related stress and strain are reviewed. Subjective reports of strain can be contrasted with other states which are often used synonymously, and/or confused, with strain, e.g. fatigue, annoyance, discomfort, boredom and anxiety. The relation of subjective states to work, and especially paced tasks, is discussed. The paper addresses work situations where the question can be raised whether stress is all that bad. Like 'fatigue', often 'strain' is a natural by-product of work, one without health consequences and bearing no relationship to work decrement. Indeed, in some situations, the amelioration of strain complaints can be achieved through work, i.e., energy expenditure.

Pearson, R. G., Shelnutt, J. B. & Casey, S. S. Combined tracking and monitoring performance over seven hours under noise. Paper presented at the International Ergonomics Association Congress. Ergonomics, 1976, 19 (3), 355-356.

Although several studies indicate that performance of a central task improves over time, while that of peripheral tasks deteriorate, especially under conditions of high subject arousal, [results of a prior study by Pearson]

showed the central task (tracking) declined over time while peripheral meter monitoring improved. [To explain this result Pearson argued] that subjects ultimately seek to increase sensory stimulation [variety] by directing attention away from the central task. Such an interpretation infers increased eye movement activity - a variable not assessed in that work. The study summarized here required pursuit tracking of a CRT display target with a joy stick control, plus concurrent monitoring of indicator movement on two peripheral panel meters. Attention to the meters required eye movements and fixation to detect movement. Twenty volunteer paid males served as subjects. For the seven-hour task ten subjects were exposed to rapid, intermittent pulses of broadband noise of 91 dB(A) peak intensity; the other ten subjects were tested under 'quiet', 35 dB(A). Eye movement activity was measured through the use of electrodes attached to the subject, and was recorded using a Grass EEG. In support of the earlier study, tracking error increased over time while response latencies in monitoring decreased. Of particular significance was the finding for frequency of eye fixations which increased over time, thus supporting the argument that more attention was being given to peripheral events at the expense of tracking. Under noise, as compared to quiet, tracking performance was poorer overall. [Also related an experiment dealing with an operator-bicycle relationship.]

Pervin, L. A. Performance and satisfaction as a function of individual environment fit. Psychological Bulletin, 1968, 69 (1), 56-68.

Research is reviewed which treats performance and satisfaction as a function of the interaction between the characteristics of the individual and those of the interpersonal and noninterpersonal environments. Relevant theoretical positions are reviewed. Alternative models for the analysis of interactions or transactions between individuals and environments are discussed. The conclusion points to and discusses 3 questions: Should one consider the perceived or "actual" environment? What units shall we employ and should they be the same units of analysis for individuals and environments? What is the nature of the processes involved in individual-environment relationships?

Pilowsky, I. Psychiatric aspects of stress. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Poulton, E. C. Arousing stresses increase vigilance. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

The optimum environment for vigilance tasks is rather more arousing than the optimum for tasks which are intrinsically more interesting. Moderate heat reduces vigilance, but heat intense enough to raise the body temperature probably increases vigilance. There may also be an increase in vigilance in mild heat which is a little uncomfortable, and an initial increase

in vigilance on first entering the heat. Vigilance declines rapidly with heat exhaustion. Continuous unvarying noises increases vigilance. Performance deteriorates only when the noise masks the auditory feedback from the man's controls which he uses in quiet, or when the noises masks the inner speech which he uses to assist his short-term memory. Intermittent or variable noise also increases vigilance, unless the task is susceptible to distraction. Vertical vibration at 5 Hz increases vigilance. This is probably because the vibration of the shoulders at this frequency can be attenuated by increasing the tension of the trunk muscles The need to tense the trunk muscles provides man with an alerting mechanism. Vigilance is high when a person in perceptual isolation is asked to perform a vigilance task. Physical exercise also probably increases vigilance, unless it is too exhausting. Unfortunately many of the potentially most useful experiments on arousing stresses use designs in which each person performs a number of conditions one after the other. The differences between the conditions are then confounded by uncontrolled transfer between conditions. The reliable interactions reported when two or more stresses are combined are also confounded by uncontrolled transfer [emphases are the author's].

Poulton, E. C. Blue collar stressors. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

There are both objective and subjective measures of stress, but the subjective measures are likely to be biased. Insufficient light and glare both reduce working efficiency. A few people cannot tolerate flickering displays. Noise produces industrial deafness. It prevents people from hearing what they want to listen to. Intermittent noise is distracting. But noise may arouse people and make them work more efficiently. Vibration blurs vision and interferes with delicate movements. But vertical vibration at 5 Hz helps to keep people alert. Slow rotary accelerations produce motion sickness. Heat usually reduces working efficiency, but may increase efficiency for a brief period. Cold hands and feet are clumsy. Gusty winds blow people around and interfere with skilled movements. Industrial processes produce dusts, mists, fumes, vapours, and gases which can harm the human body when they are breathed or get on the skin. Ionizing radiation, and electormagnetic radiation of very short wavelength, can also harm the human body. Breathing air under pressure produces nitrogen narcosis, and can produce acute oxygen poisioning, the reduced oxygen in the air high above the ground reduces the efficiency of the brain, and eventually produces unconsciousness. Rapid compression can be painful when a person has a common cold. Decompression can injure a person if it is too rapid. Heavy physical work reduces the efficiency of the brain and produces muscular fatigue, especially in people who are not physically fit. The arousal produced by intense fear also causes inefficiency. Having too much to do all at once, and having too little to do, both reduce working efficiency. People work less efficiently than usual when they are short of sleep. They also work less efficiently between 1 and 4 o'clock in the early morning, unless they are used to working then. In the absence of any valid evidence, it is safest to assume that the combined effect of a number of stressors is the sum of the individual effects.

Poulton, E. C. & Edwards, R. S. Interactions and range effects in experiments on pairs of stresses: Mild heat and low-frequency noise. Journal of Experimental Psychology, 1974, 102 (4), 621-628.

Twelve men performed 3 tasks in 102-db(C) low-frequency noise at 38-33 degrees C. (100-92 degrees F.), and with the two stresses combined, as well as in a control condition. The three tasks were tracking with peripheral lights, the five-choice task, and visual, in that order. The low-frequency noise had a beneficial effect upon all three tasks. It interacted with the mild heat on the tracking, and on false detections in the vigilance task. The results are related to behavioral arousal. When compared with a previous experiment on mild heat and loss of a night's sleep, performance in the control conditions was found to be influenced by the stresses included in the within-subjects experimental designs. This raises doubts about the validity of the interactions.

Poulton, E. C. & Edwards, R. S. Asymmetric transfer in within-subjects experiments on stress interactions. Ergonomics, 1979, 22 (8), 945-961.

A comparison is made between the results of three similar within-subjects experiments on mild heat paired respectively with the arouser low-frequency noise, and with the depressants 1 mg of l- hyoscine hydrobromide, and the loss of one full night of sleep.

Pribram, K. H. & McGuinness, D. Arousal, activation and effort in the control of attention. Psychological Review, 1975, 82 (2), 116-149.

This review attempts to organize a range of neuropsychological and psychophysiological data on attention. Three separate, but interacting, neural systems are distinguished: One controls arousal, which is defined in terms of phasic physiological responses to input. The arousal control circuits center on the amygdala. A second system controls activation, which is defined in terms of tonic physiological readiness to respond. The readiness circuits center on the basal ganglia of the forebrain. A third system is discerned which coordinates arousal and activation. This coordinating activity is defined as demanding effort. Its circuitry centers on the hippocampus. When arousal, activation, and effort are involved in problem solving, at least two further distinctions can be made. During categorizing, arousal precedes activation; during reasoning, activation precedes arousal. Finally, the review addresses the question of whether effort in problem solving is to be attributed solely to peripheral muscular factors or whether, in fact, direct monitoring of changes in brain organization (changes in set, attitude, etc.) can be productive of measurable indicators of effort.

Provins, K. A., Glenncross, D. J. C Cooper, C. J. Thermal stress and arousal. In A. T. Welford (Ed.) Man under stress. Proceeding of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Rabbitt, P. Current paradigms and models in human information processing. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

No current models in psychology specify how the functional mechanisms underlying human performance at any simple task may change their characteristics. Yet it is a blatant fact that such changes do occur. When people are practised at simple tasks it is evident that they do not simply learn to perform the same functional operations in the same way. They rather learn to perform in new and more efficient ways . . . . Yet after a hundred years of discussion and experimentation we do not even have a model which explains how simple reaction time (RT) improves with practice. Like many other investigators I have data on the effects of practice on simple RT tasks which I have not published because there is currently no useful theoretical framework in which they can be interpreted. Groups of 16 subjects reduced their simple reaction times from an average of 210 msec to an average of 165 msec after 10 days' practice in a task with variable fore-periods. After 30 days of practice they were faster still, and some continued to improve after 40 days. Yet we have no model at all for the way in which such a change comes about. At best we have the simple, unstated assumption that whatever events in the human brain intervene between the onset of a signal ad the production of an overt response early in practice also occur in the same order late in practice. The only change is that they occur faster and more efficiently.

The lack of models which allow us to describe such changes is a very severe handicap. It is not just that we cannot discuss how performace changes with practice, but that we also cannot discuss other gradual changes in system characteristics such as those which must occur as people grow up or grow old. Indeed any theory of individual differences, which implies that people may be ranked along continua of difference, demands corresponding models of performance which not only describe limiting cases but will also describe intermediate transitional states. Useful models for the effect of stressors are also impossible under any other assumptions.

Raouf, A., Hatami, S., & Chaudhary, K. CRT display terminal task pacing and its effect on performance. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis Ltd, 1981.

The effect of five baud rates on time taken and errors commited in editing a sample text using four types of alphanumeric CRT display terminals was studied. Ten subjects participated in the experiment. A 5 X 4 X 10

factorial design was used. Baud rate was found to be a highly significant factor. An optimal baud rate of 1200 bits per second was found. At this baud rate, time taken to edit the text and the number of errors committed were minimum.

Ray, W. J, Morell, M., Frediani, A. W. & Tucker, D. M. Sex differences and lateral specialization of hemispheric functioning. Neuropsychologia, 1976, 14, 391-393.

The study was designed to explore whether male-female differences in the EEG ratio of the left hemisphere to the right hemisphere could be found with general tasks which more closely approximate normal activities. Six males and six females performed tasks chosen to utilize one hemisphere of the brain more than the other. In all, there were four right hemispheric tasks and four left hemispheric tasks. The ratios of EEG power measured from the temporal lobes were statistically significant for the males between these tasks but not for the females. The results suggest that males and females process the same environmental event with different patterns of brain activity as reflected by EEG.

Reed, R. The role of stress in modern industry. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

The subject matter of this book--stress as related to machine-paced work--is certainly not a new topic among researchers. Studies have been going on since as early as the 1930's. Our union associates have been talking with us about aspects of this problem for many years. But if we look at new technology as a change, then occupational stress caused by change--any change--is certainly a contemporary concern among industrial managers. We in the Bell System have certainly become concerned about this phenomenon in recent years. And for good reasons.

The advent of the so-called 'information age' is causing significant changes in the old telecommunications technology. And nowhere is this more evident than in our own business. To keep up with new demands and to provide quality service, we find ourselves implementing new technology at an increasing pace. But such changes in technology bring with them other changes. They cause changes in work methods, require new skills among workers, demand innovative managerial techniques and often necessitate organizational changes. These events or changes at the workplace have complx relationships among them, and it is not known how exactly they impact on work life. Our own survey results show, however, that they do relate to perceived stress among workers, with possible other impacts on work efficiency and job satisfaction. I believe the effects just mentioned are not unique to our industry. Many other industries are also experiencing the same problems.

Rohmert, W. & Luczak, H. Stress, work, and productivity. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979.

Work is a dominant element of human life in all industrial societies. Work has central importance for the status and development of the national economy (production of goods and services), of the individual worker (status, life events, self-fulfilment) and the persons depending on him directly (family) or indirectly (elderly, sick, and unemployed people). Thus the stress aspects of work are manifold. A comparison of different countries shows that societies with high prosperity can be distinguished from others by their outstanding productivity. This is due partly to the fact that the individuals in these societies experience a strong pressure to aim for more qualified and more profitable work, i.e. more productivity, which causes rapidly changing situations and their consequent stress symptoms. An approach to work and productivity from the point of view of stress can be based on: (a) the process by which jobs and working places come into existence, change, and disappear, i.e. the economic and sociopolitical aspect; (b) the process by which humans become workers, i.e. the pedagogical aspect; (c) the process by which workers and jobs compete in a market for contracts, i.e. the legal and economic aspect; (d) the process of interaction of different workers in groups, i.e. the sociopsychological and sociological aspect; and (e) the process of interaction of the individual and his work, i.e. the ergonomic aspect . . . . Our subsequent presentation and discussion will concentrate on some selected ergonomic problems of man-at work systems.

Sackeim, H. A., Gur, R. C. & Saucy, M. C. Emotions are expressed more intensely on the left side of the face. Science, 27 Oct 1978, 202, 434-435.

[Pictures of human faces posing in six distinct emotions (plus a neutral expression) and their mirror reversals were split down the midlines, and left-side and right-side composites were constructed. Subjects judged left-side composites as expressing emotions more intensely than right-side composites. The finding indicates hemispheric asymmetry in the control over emotional expression in the face.]

Salvendy, G. Classification and characteristics of paced work. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

The advantages and disadvantages of machine-paced (M/P) work are reviewed and a classification of paced work is presented. Based on experimental evidence, the following results are discussed: (1) performance feedback reduces stress; (2) short rest periods between work cycles reduce stress for tasks requiring external attention, but not for tasks requiring internal attention [emphasis is the author's]; (3) no statistically significant, or clinically meaningful differences exist in psycholophysiological indicators of stress between M/P and self-paced (S/P) work; (4) no statistically significant differences exist in the quality of work performance between M/P and

S/P work; and (5) the psychological attributes of those who prefer M/P work and those who prefer S/P work are presented.

Salvendy, G. & Smith, M. J. (Eds.) Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Consists of papers presented at the First International Conference on Machine Pacing and Occupational Stress held at Purdue University 17-19 March 1981. The book is divided into eight sections covering the areas of: perspectives in work pacing and stress; models of human stress; variables relating to stress; measurement of stress; select issues in machine-paced work on stress; the impact of computer-paced work on stress; and problems in determining the relationship between production work and stress.

Sanders, A. F. Stress and human performance: a working model and some applications. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

An outline is presented of a framework aiming to relate energetical and structural mechanisms of information processing and to incorporate a cognitive stress concept in human performance research. The structural part is based upon linear stage models following the additive factor logic, while the energetical part stems from the Pribram and McGuinnes theory about the control of attention. Connections between structural and energetical mechanisms are postulated as well as the operation of cognitive evaluation mechanisms, supervising the quality of performance in relation to the actual demands. Some consequences of the framework are discussed and predictions for specific performance studies are formulated.

Sanford, J. F., Steinkerchner, R. E., Cantrell, G. K., Trimble, R. W. & Hartman, B. O. Alertness, fatigue and morale of Air Force sentries. USAF School of Aerospace Medicine, 1971.

Sauter, S. L., Harding, G. E., Gottlieb, M. S. & Quackenboss, J. J. VDT-computer automation of work practices as a stressor in information-processing jobs: some methodological considerations. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Application of video display terminals (VDTs) in information processing work may introduce stressful job-design changes sometimes associated with the mechanization and machine regulation of work. This chapter identifies some of the more unique stressors linked to working with VDTs, and discusses an appropriate methodology for studying relationships among VDT work and workplace design features, and indices of worker well being.

Schechter, G. & Buchsbaum, M. The effects of attention, stimulus intensity, and individual differences on the average evoked response. Psychophysiology, 1973, 10 (4), 392-400.

Studied the effects of shifting attention toward or away from visual or auditory stimuli of varying intensities, using average evoked responses (AERs) in 24 normal human volunteers. Ss were asked to attend to visual or auditory stimuli of 4 intensities (randomly presented) or to ignore the lights and tones and do mental arithmetic. For visual stimuli, attentional effects were largest at low intensities whereas for auditory stimuli equal effects were shown across intensities. Similar individual rates of increase of AER amplitude with increasing intensity were observed for both visual and auditory stimuli when attentional conditions were controlled. Results suggest that some general intensity processing response is reflected in the AER and that it is important to control attention in AER experiments.

Schioldborg, P. Selective attention in visual perception and short-term memory: "Stimulus" set versus "response" set. Scandanavian Journal of Psychology, 1972, 13 (3), 172-177.

Presented black or red letters or digits to each of 3 male postgraduate students in 2 experiments. The identification time of letters or digits, as selected from a mixed array of both, was longer when selection was based on the class concept "letter" or "digit" (response set) than when based on the color or position of the items (stimulus set). The difference is assumed to reflect variations in the momentary attention level of the selected items, thereby affecting the amount of information processed per unit time. Retrieval of information from short-term memory appeared to be independent of type of selection, suggesting that information processing in short-term memory includes conceptual analysis.

Schwartz, G. E., Davidson, R. J. & Maer, F. Right hemisphere lateralization for emotion in the human brain: Interactions with cognition. Science, 1975, 190, 286-288.

Right-handed subjects tend to look to the left when answering affective questions. The relative shift in gaze from right to left is accentuated when the questions also involve spatial manipulation and attenuated when the questions require verbal manipulation. The data support the hypothesis that the right hemisphere has a special role in emotion in the intact brain, and that predictable patterning of hemispheric activity can occur when specific combinations of cognitive and affective processes interact.

Selye, H. The evolution of the stress concept. American Scientist, 1973, 61 (6), 692-699.

The originator of the stress concept traces its developments from the discovery in 1936 of the alarm reaction to modern therapeutic applications of

syntoxic and catatoxic hormones. Stress-producing factors -- technically called stressors -- are different and yet they all produce essentially the same biologic stress response. The distinction between stressor and stress was perhaps the first important step in the scientific analysis in that common biologic phenomenon that we all know only too well from personal experience. [Stress is defined as:] The nonspecific response of the body to any demand made on it.

All individual, specific stressors (e.g., cold, heat, drugs, fear, joy or sadness) have one thing in common; they make an increased demand upon the body to readjust itself. The demand is nonspecific, that is, in addition to their specific actions, all agents to which we are exposed produce a nonspecific increase in the need to perform certain adaptive functions and then to reestablish normalcy, which is independent of the specific activity that caused the rise in requirements. This nonspecific demand for activity is the essence of stress. It is immaterial whether the agent/situation is pleasant or unpleasant; all that counts is the intensity of the demand for readjustment or adaptation . . . . [According to Selye] stress is not simply nervous tension, nor is it the nonspecific result of damage [Neither is stress something to be avoided] in fact, it cannot be avoided. No matter what you do or what happens to you, there arises a demand to provide the necessary energy to perform the tasks required to maintain life and to resist and adapt to the changing external influences.

The General Adaptation Syndrome (GAS), first introduced in 1936, described an alarm reaction condition as the initial response to stress. [Selye argued that this reaction probably represented the] somatic expression of a generalized "call to arms" of the body's defensive forces. [A "stage of resistance" is manifested upon continued exposure, wherein the body returns to normal body weight and functions. However, after still more exposure to the stressor] the acquired adaptation is lost again. The animal enters into a third phase, the "stage of exhaustion." The triphasic nature of the GAS gave the first indication that the body's adaptability, or "adaptation energy" is finite since, under constant stress, exhaustion eventually ensues. We still do not know precisely what is lost, except that it is not merely caloric energy, since food intake is normal during the stage of resistance. Hence, one would think that once adaptation has occurred and ample energy is available, resistance should go on indefinitely. But just as any inanimate machine gradually wears out, so does the human machine sooner or later become the victim of constant wear and tear.

Selye, H. The stress concept and some its implications. In V. Hamilton & D. M. Warburton (Eds) Human stress & cognition. New York: John Wiley, 1979.

The 'stress concept' is known in virtually all fields of medicine, pathology, biochemistry, and medical jurisprudence but also in the behavioural sciences and philosophy . . . . The panoramic overview of the subject, provided by the re-examination of all aspects of stress research, was necessary for [prior presentations] . . . . The compilation of these surveys, as

well as the many personal contacts I have had with experts during my lecture tours throughout the world, made it seem opportune at this time to present also the simplest possible synopsis of the main points.

Sen, T. K., Pruzansky, S. & Carroll, J. D. Relationship of perceived stress to job satisfaction. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Some preliminary findings are presented of a study relating perceived work stress to both overall job satisfaction and some of its psychological dimensions. Job autonomy and job demand were found to be significantly correlated to overall stress and overall satisfaction.

Sharit, J & Salvendy, G. Occupational stress: Review and reappraisal. Human Factors, 1982, 24 (2), 129-162.

This article presents an overview of the topic of occupational stress. Although its framework is somewhat conceptual, the article is intended to alert researchers to the practical considerations relevant to this topic. The authors attempt to arrive at a workable definition of stress, and then proceed to review the literature in this area, focusing on the measurement sources, and management of stress, as well as the relationship between stress and coronary heart disease. Concepts related to stress (mental load, fatigue, and arousal) are defined and differentiated. Throughout, the effects of individual attributes are emphasized, as are the implications of investigating stress in the laboratory as opposed to the work environment.

Shearer, S. I. & Tucker, D. M. Differential cognitive contributions of the cerebral hemispheres in the modulation of emotional arousal. Cognitive Therapy and Research, 1981, 5 (1), 85-93.

To examine the differential roles of the two cerebral hemispheres in emotional processes, college students viewed sexual or aversive slides under instructions to either facilitate or inhibit their emotional responses. An auditory attentional bias measure suggested that reported aversive emotional arousal was associated with relatively greater activation of the right hemisphere. Analysis of the subjects' naturalistic cognitive strategies suggested that analytic and vebal ideation was most often used to inhibit arousal, while global and imaginal thinking was used to facilitate emotion.

Shiffrin, R. M. & Gardner, G. T. Visual processing capacity and attentional control. Journal of Experimental Psychology, 1972, 93 (1), 72-82.

[Tested whether visual processing operates under attentional control, and with temporal-spatial capacity limitations. Results demonstrate simultaneous and sequential conditins to be equal. It is concluded that the initial

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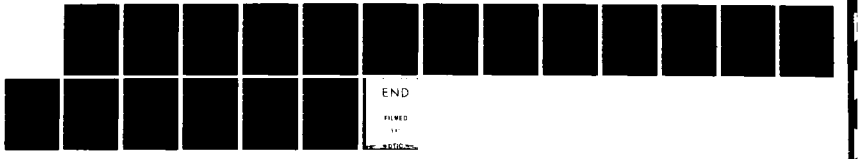

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stages of visual processing, up to at least the level of letter recognition, take place without capacity limitation and without attentional control.]

Siegel, A. Comparison of the effects of sonar monitoring and reading on cortical evoked potentials. Prepared by Applied Psychological Services, Wayne, PA, in collaboration with Neuropsycholigcal Laboratory, New York Medical College, New York, NY for the Department of the Navy, Naval Ship Systems Command, Washington, D. C., 17 June 1969.

Two subjects were studied as a function of 4 hours of observation of a sonar screen and four hours of reading light material. The order of stimulation was sonar-reading, and was reversed for subjects. Auditory CEPs were determined before and after each session. The auditory CEPs were based on 50 stimulations with white noise of 20 msec duration. Visual CEPs were determined before each condition for each subject to 50 stimulations within the Grass stimulator. Additionally, for visual, CEPs were determined to 50 stimulations after each 20 minutes of the condition, yielding 12 CEPs for each subject within each condition.

For auditory stimulation, [results indicated] a diminution in the amplitudes of the major waves after four hours of reading for both subjects and an increase in the amplitude after sonar for both subjects. Further, the results indicated a marked increase in the latency of the major positive wave for both subjects, in contrast to a very minor enhancement of a latency wave after reading. For the major negative wave, there was a large increase in the latency for one subject after observation of sonar, but no change in the latencies after reading for either subject. [Further results indicated] that observation of the visual sonar display, for as brief a periof as four hours, produced statistically significant, marked, reliable, and pervasive effects upon the amplitudes and latencies of the CEP within a relevant (visual) and irrelevant (auditory) modality.

Smith, M. J. Occupational stress: an overview of psychosocial factors. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

This paper presents a noncritical overview of the literature dealing with psychosocial aspects of occupational stress. A variety of workplace stressors that have been related to negative health consequences are discussed. In addition, three studies that have looked at the relative risk of stress problems across occupations are reviewed. The paper concludes with a discussion of future needs in occupational stress research.

Smith, R. P. Boredom: A review. Human Factors, 1981, 23 (3), 329-340.

Psychological and psychiatric studies of boredom from 1926 to the present are reviewed. Articles concerning boredom averaged less than one paper per year during the review period. The most consistent finding has been

that extroverts apparently constitute a group especially susceptible to this state, although this has not often been tested directly. Stimulus factors such as repititousness, lack of novelty, and monotony have been found to generate boredom. Coping strategies have been found to include daydreaming, motor restlessness, exploration, response variability, and withdrawal from the boring situation. Experimental approaches to the problem have generally been traditional. Attempts have consistently been made to relate boredom to altered or characteristic physiological states, but they have not resulted in a consensus concerning these biological variables.

Spielberger, C. D. The effects of anxiety on computer-assisted learning. Tallahassee, FL: Florida State University, CAI Center, June 15, 1970.

In this report, the nature of anxiety is considered in historical perspective, and the concepts of trait and state anxiety are discussed. Methods for measuring these constructs are also described. In addition, hypotheses about the effects of anxiety on learning were formulated in terms of Spence-Taylor Drive Theory and Speilberger's Trait-State Anxiety Theory, and tested in two experiments on the effects of anxiety on computer-assisted learning. It was found in these studies that state anxiety was a better predictor of performance than trait anxiety, and that performance was an interactive function of A-State and task difficulty. Some important implications for the classroom teacher of research on anxiety and learning were discussed.

Stager, P. & Laabs, G. J. The effect of divided attention on probe reaction time in multiple-task performance. Canadian Journal of Psychology, 1977, 31, (4), 174-183.

Information processing demands were examined in five experiments in which subjects performed a serial addition, pursuit tracking, or probe reaction time task separately as well as in dual- and triple-task combinations. The experiments manipulated the assigned priority and the capacity requirements of the serial addition and tracking tasks. Probe reaction time is usually assumed to reflect spare processing capacity in dual-taks studies and to increase with greater processing demands. Since probe reaction time did not increase between dual- and triple-task conditions, the results suggested that probe reaction time could be measuring spare capacity which remained relatively constant as processing demands increased. Analogous data have been reported by Wickens (1976) for a triple-task situation. These observations would not have been predicted by available models of divided-attention performance.

Streufert, S., Nogami, G. Y. & Streufert, S. C. Stress and incongruity theory: Effects of crowding. University Park, PA: Pennsyvania State University, February 1981.

The General Incongruity Adaptation Level Theory. [A distinction is made] between the concept of congruity-incongruity and the concept of consistency-inconsistency. There are expected levels of incogruity that an individual can sustain before reacting to maintain his "space" [this should apply to cognitive or physical space]. Any great inconsistency in, above or below, the expected "incongruity level" produces stress and coping mechanisms. [If the person cannot gain or maintain control he] is likely to stop attempting to utilize ineffective cloze actions (learned helplessness). He would experience considerable negative affect and would likely respond to decrese the excessive incongruity via withdrawal from social contact, via distortion, or via aggression. The more severe the density and other associated effects in residential crowding, the longer the condition is maintained, and the less the person is able to deal with the problem directly, the more extreme one might expect these maladaptative responses to be.

Stromme, S. B., Wikeby, P. C., Blix, A. S. & Ursin, H. Additional heart rate. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

In a previous report Blix, Stromme, and Ursin (1974) presented a case for the usefulness of "additional heart rate" as an indicator of psychological activation. This concept is based on the fact that a fairly linear relationship exists between oxygen uptake and heart rate under aerobic (steady-state) conditions. Consequently, if in any situation heart rate exceeds the value predicted from the actual oxygen consumption of the subject, then the additional heart rate is likely to be due to some kind of psychological activation. Simultaneously measuring heart rate and oxygen uptake when the parachute trainee approached the edge of the upper mock tower platform enabled us to calculate his "additional heart rate". This additional heart rate value might be a valid indicator of even very transient psychological activation, which might not appear in the endocrine measurements.

For all test days, there was a clear "additional heart rate," but only immediately before the jump. Almost no additional heart rate could be detected as late as 280 sec before the jump, not even on the first day . . . . Just before the jump, as well as just after it, a rather large increase in additional heart rate (40 and 60 bpm, respectively) was observed.

Swain, A. D. & Guttmann, H. E. Handbook of human reliability analysis with emphasis on nuclear power plant applications; draft report for interim use and comment (NUREG/CR-1278). Albuquerque, NM: Sandia Laboratories, prepared for U.S. Nuclear Regulatory Commission, October 1980.

Takakuwa, E. The function of maintaining concentration (TAF): An approach to the evaluation of mental stress. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

If the essential nature of fatigue were to be grasped physiologically or biochemically, there would be no difficulty in finding an appropriate approach to the evaluation of fatigue. However, there seem to be no reliable tests of fatigue among those in current use. For this reason, we initiated a new concept of "the function of maintaining concentration (TAF)," and on the basis of this concept we devised the TAF (Target Aiming Function) test. Using the TAF test, a series of field investigations and experimental studies was carried out in regard to the autonomic nervous function. in this paper, a few studies on TAF in relation to vigilance are introduced. Stresses in pilots caused by repeated jet flights and in workers engaged in a vigilance task with and without a conveyer system were studied and experiments were conducted on the relationship between autonomic nervous balance and TAF scores. The results were as follows:

(1) TAF scores accurately reflected qualitative differences in performing a vigilance task and clerical work, and clarified certain differences among workers on different shifts as well as between conveyer and non-conveyer systems. (2) In pilots, the TAF test scores showed significant changes after repeated jet flights in proportion to the degree of their subjective feelings of fatigue. (3) The changes caused in the autonomic nervous balance by stress stimuli showed a significant correlation with the changes in TAF scores.

Triggs, T. J. Perceptual narrowing and forced-paced tasks. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

Human operators under task-induced stress conditions are frequently regarded as undergoing a 'narrowing' of their visual perceptual field. Typically, the effect has been demonstrated by the decrements in responding to peripheral visual signals as the task demands of a central or primary task are increased [emphasis is the author's]. This paper discusses the criteria that must be satisfied before the phenomenon of perceptual narrowing can be deemed to have occurred. These are based on the statistical requirement to show a significant interaction between the factors of visual angle and task demand for performance on the peripheral task, and the need to avoid floor or ceiling effects. Data from several experiments are presented using forced-paced central tasks with different input rates that argue against the generality of the concept of perceptual narrowing.

Trumbo, D. A. Some laboratory tasks for the assessment of stressor effects. Psychiatria, Neurologia, Neurochirurgia, (Amst.), 1973, 76 (3), 199-207.

[The issues involved in choosing between 'real-life' and laboratory tasks are reviewed briefly, and the problems associated with the selection of a set of laboratory tasks are discussed. It is suggested that tasks and task variables be selected for their potential contribution to our understanding of the specific effects of stressors on human information processing and on underlying mechanisms. Several prototype tasks are presented, including: vigilance, serial reaction, reaction time and choice reaction time, simple bi-phasic movement, tracking, and dual or time sharing tasks. Each of these tasks shows promise of providing specific information about the locus and nature of stressor effects. It is concluded that research on stressors should involve multiple tasks, multiple performance indicants including physiological measures, and should be directed toward an analysis of the interactions of pharmacological and other stressor effects. Criteria for task selection]:

(1) Frequency (responses per unit of time; can be used in vigilance and serial reaction tasks). (2) Coherence (correlation of signals and responses; can be used in estimation and decision tasks). (3) Continuity (extent to which signals are continuous or discrete; can be used in tracking and balancing or tapping tasks).

Prototype tasks: 1. Vigilance; 2. Serial reaction tasks (1 and 2 have been researched extensively): (a) Simple reaction time (RT), (b) Choice reaction time (CRT), and (c) Bi-phasic/discrete choice reaction time (BP); 3. Tracking tasks; 4. Time-sharing tasks. These tasks were chosen because they have been found useful in exploring some rather well-established models of human performance. What is needed is the precise specification of where the effects of the task occur in the course of information processing. [Trumbo concedes that it may be impossible at this time to precisely specify the locus of effect, and that stressors may affect the entire information processing system.]

Tucker, D. M. Sex differences in hemispheric specialization for synthetic visuospatial functions. Neuropsychologia, 1976, 14, 447-454 (Pergammon Press, England).

Right-handed normal males and females performed two visuospatial tasks, one requiring perceptual synthesis, one requiring more perceptual analysis and a vocabulary task. EEG analysis indicated right hemisphere specialization for males for the synthetic visuospatial task and greater desynchrony in the occipital region for females on the analytic visuospatial and vocabulary tasks. The results are discussed with reference to the effects of bilaterial representation upon the compatibility of synthetic and analytic psychological functions and the importance of considering regional as well as hemispheric specialization.

The results of the study suggest that there are considerable sex differences in brain function. In the present data these included not only differences in hemispheric specialization, but differences in regional usage as well. In the ANOVA in the distribution of alpha power over the cortex, females showed significantly greater desynchrony in the occipital regions than males on the Gottschaldt and vocabulary tasks. Such data are difficult to interpret, but may suggest that, compared to males, females use the occipital regions for complex perceptual processing as well as for simple reception of the visual input. The results indicated significant asymmetry-performance correlations only for the males on the Mooney task. The results of the vocabulary task showed a left temporal association with speed of correct responding which approached significance only in the males' data. The implication of such data is that the left hemisphere is more specialized in males than in females for at least some kinds of verbal processing.

Tucker, D. M. Hemispheric differentiation, integration and cognitive style. Grand Forks: Univ. of North Dakota, Psychology Dept., 1978.

In an investigation of the relationship between brain function and field dependence, 80 college students were administered tests of field dependence and lateral eye movement measures of hemisphereic function. Field dpendence was found to characterize subjects who showed left movements to spatial questions and right movements to verbal questions. Field independence was associated with a greater frequency of non-lateral responses, suggesting relatively bilateral hemispheric activation. This relationship between field independence and non-lateral responses was also observed in a sample of 3-year-old children. The ability to combine the capacities of both cerebral hemispheres appears important to a field independent cognitive style.

Tucker, D. M. Lateral brain function, emotion, and conceptualization. Psychological Bulletin, 1981, 89 (1), 19-46. (a)

Research on brain damage, psychiatric disorders and normal emotion has shown the importnce of the right hemisphere's holistic and nonverbal conceptualization to emotion. Studies of hemispheric asymmetries in psychiatric patients have suggested the importance of specific and apparently lateralized arousal systems in the brain that support the differential cognitive capacities of the two cerebral hemispheres. The operation of these arousal systems seems to vary closely with the individual's affective stte. The research on emotional effects of unilateral lesions has suggested that the hemispheres may be specialized not just for the kind of emotion but for its valence, positive or negative. Research issues and methods in this area are still at an early stage of development, yet it seems clear that further research on the lateralization of emotion should reveal how emotional processes are at one level dependent on basic neurophysiological activation processes an at another level intrinsic to the differential forms of conceptualization of the two cerebral hemispheres.

Tucker, D. M. Personal communication to G. W. Lewis, September 14, 1981. (b)

Tucker, D. M., Antes, J. R., Stenslie, C. E. & Barnhardt, T. M. Anxiety and lateral cerebral function. Journal of Abnormal Psychology, 1978, 87 (3), 380-383.

In an initial experiment, subjects reporting high anxiety evidenced a performance decrement that was specific to tasks presented to the right visual half-field. Given this suggestion of left-hemisphere involvement in anxiety, a second experiment examined attentional bias and lateral eye movemenents; high trait anxiety was associated with a right-ear attentional bias and a low incidence of left lateral eye movements. These observations suggest that anxiety, as an individual difference variable, might entail a lateral shift in cerebral function.

Tucker, D. M. & Newman, J. P. Verbal versus imaginal cognitive strategies in the inhibition of emotional arousal. Cognitive Therapy and Research, 1981, 5 (2), 197-202.

The comparison of the effect of cognitive strategy upon autonomic arousal, indicated that the verbal/analytic strategy was more effective than the imaginal/global one in decreasing bilaterial peripheral vasoconstriction, and thus sympathetic arousal, as the subjects viewed the emotional material.

Tucker, D. M., Ray, W. J. & Stern, R. M. Cognitive structure and EEG asymmetry. Paper presented at the annual convention of the Society for Psychological Research, Salt Lake City, 1974.

The data did not point to single hemisphere superiority for any of the tasks over all subjects. Rather, the subjects demonstrated a variety of EEG patterns, which in some cases showed that utilization of one region in one hemisphere and a different region in the other hemisphere was associated with rapid processing of the task.

Tucker, D. M. & Roth, D. L. Factoring the intercoherence matrix: Multivariate analysis of topographic covariance in the EEG (manuscript in preparation). Grand Forks, ND: University of North Dakota, Dept. of Psychology, 1982.

A problem in current EEG research is appropriately handling the large amounts of data acquired so that the topographic patterning of the electrophysiologic activity can be characterized and related to differential usage of brain regions during specific forms of cognition. Multivariate analysis can be productively applied to describe the spatial patterning of covariance in the spectral information of a multichannel EEG. Coherence factors show good replicability over repeated observations, and lateralized cognitive activity

produces clear changes in factor loadings. This method illustrates the utility of applying descriptive mathematics to digital analysis of the electrical activity of the cortex.

Tucker, D. M., Roth, R. S., Arneson, B. A. & Buckingham, V. Right hemisphere activation during stress. Neuropsychologia, 1977, 15, 697-700.

To examine the effects of psychological stress upon hemisphere activation, subjects' lateral eye movements to reflective questions were observed under conditions of neutral instructions and instructions designed to be stressful. An increased frequency of left eye movements during the stress condition suggested greater right than left hemisphere activation with emotional arousal.

Tucker, D. M. & Sanstead, H. H. Spectral electroencephalographic correlates of iron status: Tired blood revisited. Physiology and Behavior, 1981, 26, 439-449.

For some time, clinical reports have described impairment of affective and cognitive functions in iron deficient persons. Recent studies suggest that both brain biochemistry and cognitive performance capacity may be disrupted by inadequate intake of dietary iron, but the relationship of the possible neurophysiological effect to psychological ones is unclear. To examine the reltionship of iron status to simultaneous measures of cortical activation and cognitive performance, 8 channels of electroencephalographic (EEG) data were recorded during a resting period and during the performance of several cognitive tasks in two groups of men. The EEG data were spectrally analyzed, and measures of total power and frequency of peak power in each of several bands of the power spectrum for each channel were used as predictors in multiple regression analyses with serum iron and serum ferritin as alternative criteria. Measures of power in the delta frequency in the resting period appeared relevant to iron status in both groups, perhaps indicating alertness or arousal level. Consistently in these regressions, the asymmetry of the EEG appeared relevant to iron and ferritin. These findings suggest that the combination of EEG and performance measures may help characterize the neuropsychological effects of trace element nutrition . . . . If iron deficiency disrupts the biochemistry of one or more of the neurotransmitters, it would seem reasonable that the effects may be lateralized, and may be evident in asymmetrical electrophysiological indices of cortical activation . . . . The two cerebral hemispheres are differentially specialized not only for cognitive functions, but for emotional processes as well.

Tucker, D. M., Stenslie, C. E., Roth, R. S. & Shearer, S. L. Right frontal lobe activation and right hemisphere performance decrement during a depressed mood. Archives of General Psychiatry, Feb 1981, 38, 169-174.

Evidence from psychiatric patients has suggested that depressive affect may coincide with a decrement in the functioning of the right cerebral

hemisphere. We have observed that college students who reported greater depression also reported less vivid imagery. Students undergoing experimental induction of depressive and euphoric moods in the laboratory showed an auditory attentional bias and impaired imagery during the depression condition, while arithmetic task performance was unchanged. A second mood-induction experiment indicated a depressed mood to be characterized by asymmetrical EEG activation over the frontal lobes, with relatively greater activity in the right frontal region. These observations suggest that anterior regions of the brain may modulate the differential effect of emotional arousal upon the information-processing capacities of the cerebral hemispheres . . . . It seems then, that the right hemisphere dysfunction in depression may not reflect a chronic neurologic condition, but may indicate some transient process that is related to the depressive affect itself or possibly to the changes in arousal that accompany depression. (p. 170)

Tyler, S. K. & Tucker, D. M. Anxiety and perceptual structure: Individual differences in neuropsychological function. Journal of Abnormal Psychology, 1982, 91, (3), 210-220.

Previous research has suggested that characteristically anxious persons show high left hemisphere activation. We studied the cognitive performance of high and low trait anxious subjects under conditions of high and low situational stress, using tasks requiring greater contributions of the right or left hemisphere. In addition, a perceptual task was adapted from visual information processing research that assesses whether a subject uses a global or an analytice approach to perception; if anxiety increases the left hemisphere's contribution to perception, anxious persons might be expected to be more analytic and detail-oriented. The results showed no significant differences on left hemisphere tasks, but a significant interaction of trait by state anxiety for right hemisphere tasks: low trait subjects performed better and high trait subjects performed poorer under situational stress. Trait anxiety showed a significant main effect on visual information processing strategy, low trait anxious subjects tending to be more global and high trait anxious subjects tending to process the stimulus analytically. These results provide further support for the utility of a neuropsychological model in describing the effects of emotion on perception.

Ursin, H. Activation, coping, and psychosomatics. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

The findings reported in this book are very consistent, at least with regard to the group data. We found a relative basal or reference value in our "basal" sample, a very clear and significant change from this basal value on the first jump, and a general return to basal levels when the jumps were repeated. We regard this change as crucial evidence for coping having taken place. Our main hypothesis was confirmed for all of the physiological variables except heart rate . . . . The effects on health of "stressors" or environmental factors do not depend on the external situation, but on how

each individual experiences the situation. The objective dangers or the strain from a physical point of view are not what elevate the "stress" hormones; psychological variables like defense, expectancy, and trust in the coping abilities of each man determine the response. Therefore, it is not very meaningful to concentrate on the situation itself. This could also influence the experience and expectancies of outcome of such life situations, and this may lead to self- fulfilling prophecies. All evaluations of relationships between the external world and the challenges on health must take into consideration that the conclusions reached may affect the health situation of large populations once they are dissemminated through modern mass media. If a population is led to believe that there is a particular relationship between a certain physicial state and health, this may become true, not because it was true originally, but because the population was led to expect either health or disease form that particular variable. This is a new principle in health and health care, and much more attention must be paid to this variable. We should approach this problem area with the necessarry understanding of the very potent psychological mechanisms that are involved. We believe that the bulk of the data point to the importance of being able to cope with the challenges of every day life. The stress response is a healthy activation in healthy individuals, and we should not tell anyone that increassed heart rate, sweating in the palms of the hands, and an inner feeling of tension and activation are indications of impeding death. Such attributions of experiences of peripheral activation may have health consequences. If we convince people that completely normal responses such as increased heart rate and sweating in challenging situations are pathogenic factors, they may indeed become pathogenic. If these everyday experiences are interpreted as normal and healthy responses, they remain so.

Ursin, H., Baade, E. & Levine, S. (Eds.). Psychobiology of stress. New York: Academic Press, 1980.

This interdisciplinary study deals with the contribution of psychological factors to biological responses in a life stress situation. The study focused on a group of normal adult males in a situation of severe training -- as army paratroopers. Changes in their biological responses reveal the importance of coping, a psychological process, in modifying the body's response to stress. The relevance of these results to health and disease in general populations is extensively discussed.

Ursin, H., Blix, A. S. & Rosseland, S. Subjects and the methods used in the field phase of the experiment. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

Van Harrison, R. Person-environment fit and job stress. In C. L. Cooper & R. Payne (Eds.) Stress at work. New York: John Wiley, 1978.

The first section of the chapter presents a general theory of the interrelationship between the person and the environment The process of adaptation

is described within this framework. The second section presents a more detailed consideration of the relationship between stress and the degree of fit between the person and the environment. The theory is used to predict relationships between strain and person--environment (P-E) fit. The third section presents data relevant to the theoretical predictions and the findings are used to evaluate the usefulness of the theory. The fourth section presents suggestions for reducing job stress which follow from the theory. The chapter concludes with some suggestions concerning future research and development of the theory . . . .P-E fit theory as developed by French et al. (1974) emphasizes the theoretical necessity of the causal link between P-E fit and strain: Though the necessity of the causal link is widely recognized, the exact content and processes of that link remain unclear. Factors determining which type of strain(s) will occur in response to P-E fit include: (1) motive(s) which are not being met; (2) genetic and social background of the individual; (3) defence and coping predispositions of the individual; and (4) situational constraints on particular responses.

Vollmer, F. Motivational and physiological arousal. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

The subjects in the present study were faced with the task of learning basic parachutist jumping techniques. To this end they were subjected to several weeks of training involving jumping from a tower. Performance gradually improved during the training phase. The reason for selecting this task for study was that it was judged to be a highly threatening and fear-provoking situation. As such, it was considered an ideal situation in which to test a number of hypotheses regarding relationships between degree of threat experienced in a situation, on the one hand, and physiological arousal/subjective fear on the other. For instance, will improvement in performance/skill lead to a change in experience of the situation's degree of threat and thereby to a change in subsequent physiological arousal/subjective fear? Will defense mechanisms to some degree determine how threatening the situation is perceived to be and therefore also be related to physiological activation?

Warburton, D. M. Physiological aspects of information processing and stress. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979. (a)

In everyday conversation how often have we heard expressions like 'a hard day at the office'; 'trying to do two things at once is a strain'; 'it is very wearing adding these figures and trying to ignore the other people's conversation'; 'I got worn out just waiting for you'; 'it is the uncertainty that upsets me'. All of these phrases express the feeling that it is not only physical effort that is tiring, but that mental work and uncertainty can produce feelings of fatigue that are just as strong as those produced by physical work. It is easy to understand that muscular activity produces exhaustion because muscular contraction consumes energy, but it is less clear

how mental effort can be just as tiring as physical effort. In this chapter, I will consider how the brain copes with the demands of information processing, and how an enevitable consequence of the attention devoted to the task is the stress response. If the stress response is prolonged, fatigue will result. In the next two sections the concepts of information processing in the nervous system and stress will be considered. In the fourth section the physiological aspects of attention will be outlined. The fifth and sixth section will deal with electrocortical activity, drugs, and cognition. The seventh section will discuss the physiological stress response, and in the eighth section there are speculations about the fatigue that results from mental work.

Warburton, D. M. Physiological aspects of anxiety and schizophrenia. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979. (b)

In the past there was a dichotomy between neurologists who believed that there was a structural defect or toxic chemical that produced mental disorder and psychiatrists who believed in psychological causation, but were unable to explain the success of somatic therapies expect in the most trivial terms. The more extreme psychonalytically oriented theerapists even regarded drugs as chemical straghtjackets that had no therapeutic value and, on the contrary, could actually interfere with the process of psychotherapy (Meerloo, 1955; Szasz, 1957). However, more eclectic therapists conceive of experiences of the mind as the result of an interplay of many levels (Mandell, 1968). Neural activity is the result of dynamic chemical changes in the nervous system. There is complex interaction between the cortical and subcortical structures, and the balance of activity in the neural networks is a consequence of the external environment and past experience which determines the cognitive interpretation at the cortex. This view will be called the mind-brain interaction model.

In accord with this eclectic model, therapy is not based on the structural change model of mental illness but on the view that mental illness is produced aas a consequence of environmental events which act on the nervous system. This view does not deny that there may be some genetic influences which may be important in the aetiology. However, the illness is usually precipitated in the adult by the action of psychological factors on the nervous system. In this scheme childhood experience can have two possible influences; first, by acting on the nervous system directly and modifying the pathways before they are fully developed and second, by determining the sorts of adult experience which will be likely to precipitate illness. In addition, the precise symptoms displayed by the patient will have their origins in the development of the individual . . . . This mind-brain interaction model will be discussed with reference to anxiety and schizophrenia.

Warburton, D. M. Stress and the processing of information. In V. Hamilton & D. M. Warburton (Eds.) Human stress & cognition. New York: John Wiley, 1979. (c)

In summary, psychological stressors must be considered with respect to the individual, and the stress response will be a function of the person's evaluation of the input. This definition of stressors in subjective terms does not differentiate 'psychological' stressors from 'physical' stressors. All physical stressors (work, noise, pain, etc.) have psychological effects, and it is impossible to separate out the respective stress effects on the person. Mason (1971) suggests that the stress should be considered as a behavioural concept, not a physiological concept, because of the involvement of the higher levels of the central nervous system. Certainly the stress responses are the same for 'pure psychological' and 'pure physical' stressors . . . . As Selye (see Theories of Stress) has indicated, the stress response is a non-specific response to any demand and it prepares the organism for action. All the evidence suggests that the response is stereotyped and independent of the nature of the stressor.

From what has been discovered, it seems that the cognitive changes also represent preparations for action in an emergency. In a dangerous situation it is obviously more adaptive to be highly selective in the stimuli processed than to store information; to act quickly and risk mistakes rather than act slowly and carefully; to focus on one problem than to think divergently and creatively. Altogether the stress response consists of a pattern of physiological and cognitive changes that have evolved for mental and physical action . . . . The major problem for future research is how we can organize our society so that we can have the 'stress without distress' for which Selye argues. From the work cited in this volume it seems that distress occurs when the stressor-person interaction is too intense, too uncertain, and too prolonged. As we come to understand the way in which we process information and develop integrated cognitive models . . . then we can train people to optimize their processing capacities. When we understand the changes that occur with information overload, we will be able to design tasks to allow for the inevitable shift in the balance of cognitive abilities that occurs with high levels of stressors.

Ware, R. & Baker, R. A. The effect of mental set and states of consciousness on vigilance decrement: A systematic exploration. In R. R. Mackie (Ed.), Vigilance: Theory, operational performance, and physiological correlates. New York: Plenum Press, 1977.

Previous research by the authors and others has shown the human operator to be a nortoriously inefficient monitor. Unless motivation is unusually high and stringent and unusual methods are employed, infrequent, aperiodic, and near-threshold signals are rarely detected. Failure to head such cues or signals in either the natural or manmade environment in hundreds of military, industrial, or everyday situations could--and often does--prove disastrous. To increase the alertness level and reduce the typical vigilance decrement researchers have increased and decreased the signal

rate, signal variability, signal intensity, and signal complexity. Both positive and negative feedback have been provided and environment stimulation has been systematically increased, decreased, and varied in quality. In fact, nearly everything imaginable has been tried with only moderate success in increasing the level of sustained alertness.

Although a number of personality, motivational, and individual difference variables have been studied, very little research on the effect or influence of internal states--with the exception of the effect of some of the more popular drugs and narcotics--has been undertaken. Particularly noticeable by its absence is systematic research on the influence of mental set or suggestion or levels of consciousness. To our knowledge no one has explored the vigilance performance of subjects (Ss) while in the hypnoidal state or while under the influence of post-hypnoidal suggestion. It seems reasonable that if Ss can be put into, and/or can be helped to maintain, a state of hyper-alertness by or through any means whatsoever, superior vigilance performance should result. In fact, some exploratory research along these lines has been carried out.

Observations of hundreds of subjects have led the authors to suggest that monitoring efficiency is directly related to the S's task orientation, i.e., his ability to control his attentional shifts and their focus and drift. If, for example, the monitor's flights of fancy are related to or are concerned with elements or aspects of the vigilance task itself, there will be little or no decrement in the level of vigilance as the watch continues. This paper presents the results of some exploratory research testing this task-orientation or self-awareness control hypothesis and outlines a program of research for systematically exploring this hypothesis.

Waugh, N. C. & Norman, D. A. Primary memory. Psychological review, 1965, 72, (2), 89-104.

A model for short-term memory is described and evaluated. A variety of experimental data are shown to be consistent with the following statements. (a) Unrehearsed verbal stimuli tend to be quickly forgotten because they are interfered with by later items in a series and not because their traces decay in time. (b) Rehearsal may transfer an item from a very limited primary memory store to a larger and more stable secondary store. (c) A recently perceived item may be retained in both stores at the same time. The properties of these 2 independent memory systems can be separated by experimental and analytical methods.

Weiss, H. M., Ilgen, D. R. & Sharbaugh, M. E. Effects of life and job stress on information search behaviors of organizational members (ONR-7, Interim Rpt.). West Lafayette, IN: Purdue University, N00014-78-C-0609/NR170-876, April 1979.

The relationship of stressful life events in and out of work to role relevant information search was examined. It was suggested that stressful life

events lead a person to question the appropriateness of typical modes of role enactment resulting in increased role relevant information search. Forty-four individuals employed in a wide variety of organizations completed questionnaires measuring two types of stessful events (life and work) and role related information search in two settings (on and off the job). Results showed that stressful events significantly predicted information search activities. However, work related stressful events predicted information search conducted on-the-job while life stress predicted off-the-job search . . . . Stressful life experiences outside of work were measured using the Homes and Rahe (1967) Schedule of Recent Experiences (SRE) . . . . Stressful events at work were assessed uing the Naismith (1975) Organizational Readjustment Rating Scale (ORRS) . . . . The results of our study supported the expected relationship between stressful life events and search activites. Furthermore, the effects of stressful events on search behavior were found to be domain specific. That is, work related stressful events were found to predict on-the-job search activities only, while stressful life events were found to me most predictive of searching for role relevant information off-the-job (p. 13).

Weitzman, E. D. & Ursin, H. Growth hormone. In H. Ursin, E. Baade & S. Levine (Eds.) Psychobiology of stress. New York: Academic Press, 1978.

There are several reasons for studying growth hormone (GH) when the internal state of a coping individual is to be evalutated. GH has been shown to increase under conditions of acute pain, fear, or other anxiety-provoking situations. In this regard, GH responds in a manner similar to that of the adrenocorticotropic- cortisol system and the catecholamines. In addition, GH has a unique feature compared with the other hypothalamic-pituitary- controlled hormones, in that its plasma concentration is usually zero, or very near zero, and therefore a behaviorally evoked stimulus gives a clear, sharp, separate secretory response. Since a GH secretory response can also be induced by rapid change in the plasma concentration of certain amino acids, circulating blood factors might also induce a GH response under cerain circumstances. It has been shown that the central nervous systmem is the probable major control site for the release of GH through inhibitory and stimulatory hypothalamic-pituitary releasing polypeptide hormones . . . . The fact that the concentration of GH is essentially zero under conditions of quiet wakefulness makes this psychoendocrine system a potentially ideal one for such a purpose, because it avoids the question of "initial values."

Welch, R. The measurement of physiological predisposition to tenosynvitis. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Welford, A. T. Stress and performance. Ergonomics, 1973, 16 (5), 567-580.

The effects on performance are discussed of various types of stress deriving from imbalance between capacity on the one hand and, on the other, the demands of tasks, environmental conditions and social situations which either overload or underload the individual. Common cybernetic principles seem to apply over an area which includes not only stress, but also motivation and arousal. A model is proposed which ties together three previously existing models current in this field: the Inverted-U Hypothesis, Signal Detection Theory and the Yerkes-Dodson Law. The model is examined further in relation to individual differences of personality and to problems of conserving talent among students and those carrying heavy executive responsibility.

Welford, A. T. (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Welford, A. T. Stress and performance. In A. T. Welford (Ed.) Man under stress. Proceedings of the Ninth Annual Conference of the Ergonomics Society of Australia and New Zealand, University of Adelaide, 24-25 August 1972. New York: John Wiley, 1974.

Wilkins, W. L. Psychophysiological correlates of stress and human performace. In E. A. Alluisi & E. A. Fleishman (Eds.), Human performance and productivity: Stress and performance effectiveness. New Jersey: Lawrence Erlbaum Associates, 1982.

The present chapter attempts to call attention to some of the research approaches available through environmental physiology as well as psychophysiology. From the research literature, of how physiological monitoring of persons working on the job can hopefully supply us with new information about how stressful the work is, and whether strain results from overload or underload, from physical, psychological, or environmental factors. It is assumed that the criteria against which efficiency on the job should be judged should include physiological criteria as well as economic, psychological, and sociological ones. The first section reviews a portion of physiology that is most directly relevant to the study of work life, and presents some details of psychophysiology that is a subdiscipline of both physiological psychology and physiology. In psychophysiological research, behavioral activities -- or mental or emotional ones -- are brought about, and the physiological events that accompany them are carefully assessed.

Wisner, A. Organizational stress, cognitive load and mental suffering. In G. Salvendy & M. J. Smith (Eds.), Machine pacing and occupational stress. London: Taylor & Francis, Ltd., 1981.

The evolution of technology (computerization, automation) connected with classic or recent types of work organization gives rise to situations where activity is not far off being purely cognitive, even in mass-production or low-qualified office work. Many activities like agriculture or nursing, now have a strong and complex cognitive component. In these conditions, a precise analysis of mental activites at work must be undertaken (perception, identification, decision, short-time memory, programmes of action). This analysis is related not so much to what employees are supposed to do but to what they are really doing.

The signs of mental suffering (complaints, neurotic behavior, psychosomatic diseases) can then be related to specific aspects of groups of tasks. These aspects characterize especially dangerous types of organization. Among them it is legitimate to put paced work, but also conflicting situations, current use of multiple codes, frequently interrupted tasks, activities inducing self-acceleration, etc.

Zimmer, Herbert (Ed.) Computers in psychophysiology. Springfield, IL: Charles C. Thomas, 1966

The drive toward automation of psychophysiology laboratories derives its impetus from the excessive costs, inaccuracies and delays inherent in employing human operators to perform the task of data reduction. This traditional method of reduction is practical only for single-channel recording. Since the degree of involvement of various organ systems during any given experimental procedure is still a matter for much additional investigation, the study of any single channel of data is of necessity treacherous. With single-channel recordings, the most relevant response variables could be overlooked, and possibly have been, in hundreds of experiments. For this reason, many serious psychophysiologists have made a commitment to record most of the physiologic signals which have possible relevance to the problem under study. The data so collected are then treated as samples of behavior, drawn from a larger population of behavior . . . . The production of one or several instances of a successfully elicited response may constitute a useful demonstration, but has ceased to be considered serious evidence decades ago. This resolves the issue of how much of the collected information requires processing: most of it does. Cost considerations make any remarks about the hoarding of excessive or redundant data more superfluous than ever. At the same time, they enhance the appeal of analog, editing and signal conditioning devices as means of recording only the most relevant aspects of a physiologic signal. [This volume] is a comprehensive account of representative systems . . . all applicable to psychophysiologic problems and capable of generating data in digital form. With one exception the systems included produce data in a format suitable as input to a general purpose computer.

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